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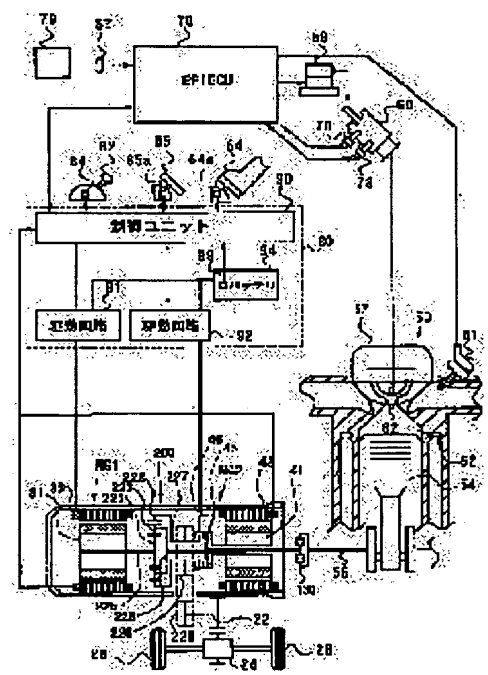
## (54) POWER OUTPUT UNIT AND CONTROL METHOD THEREFOR

(57)Abstract:

PROBLEM TO BE SOLVED: To efficiently transmit output power from a prime mover to a drive shaft by an arrangement wherein the rotary shaft of a second motor coupled with the drive shaft can be coupled with the output shaft of the prime mover and the drive shaft or can be uncoupled therefrom.

SOLUTION: The rotary shaft of a rotor 41 in a motor MG2 is coupled mechanically which a crankshaft 56 or uncoupled therefrom through a first clutch 45 which is disposed between a planetary gear 200 and a motor MG1. Furthermore, it is coupled mechanically with the ring gear shaft 227 of the planetary gear 200 through a second clutch 46. Consequently, the occurrence of power circulation can be avoided, and the overall efficiency of the apparatus can be enhanced.



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CLAIMS

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[Claim(s)]
[Claim 1] The prime mover which is the power output unit which outputs power to a driving shaft, and has an output shaft, The 1st shaft combined with said output shaft, and the 2nd shaft combined with said driving shaft, The power means of communication with which the power outputted and inputted by one residual shaft will be determined if the power which has the 3rd different shaft from this 1st shaft and the 2nd shaft, and is outputted and inputted by two shafts among these is determined, The 1st motor combined with said 3rd shaft, and the 2nd motor which has a different revolving shaft from said output shaft and said driving shaft, and exchanges power through this revolving shaft, A power output unit equipped with the 2nd connecting means which performs mechanical connection between the 1st connecting means which performs mechanical connection with said revolving shaft and said output shaft, and discharge of this connection, and said revolving shaft and said driving shaft, and discharge of this connection.
[Claim 2] Said the 1st connecting means and said 2nd connecting means are [ both ] a power output unit according to claim 1 which it comes to constitute with a clutch.
[Claim 3] The power output unit according to claim 1 or 2 which comes to arrange said driving shaft and said output shaft on the same axle.
[Claim 4] The power output unit according to claim 3 which comes to arrange the revolving shaft of said 2nd motor on said driving shaft and said output shaft, and same axle.
[Claim 5] The power output unit according to claim 4 which it comes to arrange from said prime mover in order of said 2nd motor and said 1st motor.
[Claim 6] The power output unit according to claim 5 which comes to arrange said the 1st connecting means and said 2nd connecting means between said 2nd motor and said 1st motor.
[Claim 7] The power output unit according to claim 3 which comes to arrange the revolving shaft of said 2nd motor on a different shaft from said driving shaft and said output shaft.
[Claim 8] The power output unit according to claim 1 or 2 which comes to arrange said output shaft and said driving shaft on a different shaft.
[Claim 9] The power output unit according to claim 8 which comes to arrange the revolving shaft of said 2nd motor on said output shaft and same axle.
[Claim 10] The power output unit according to claim 8 which comes to arrange the revolving shaft of said 2nd motor on said driving shaft and same axle.
[Claim 11] Said 1st connecting means is a power output unit [ equipped with a gear change means to change gears and to transmit the rotational frequency of the revolving shaft of said 2nd motor to said output shaft ] according to claim 1.
[Claim 12] Said 2nd connecting means is a power output unit [ equipped with the change gear which changes gears and transmits the rotational frequency of the revolving shaft of said 2nd motor to said driving shaft ] according to claim 1 or 11.
[Claim 13] There is no claim 1 equipped with the connection control means which controls said the 1st connecting means and said 2nd connecting means based on the operational status of said prime mover,

said 1st motor, said 2nd motor, and said driving shaft or predetermined directions, and it is the power output unit of a publication 12 either.
[Claim 14] It is a power output unit according to claim 13. Said connection control means When it is in the condition as said operational status that the rotational speed of said output shaft is larger than the rotational speed of said driving shaft, Said 2nd connecting means is controlled so that this revolving shaft and said driving shaft are connected, while controlling said 1st connecting means so that connection between the revolving shaft of said 2nd motor and said output shaft is canceled. When it is in the condition as said operational status that the rotational speed of said output shaft is smaller than the rotational speed of said driving shaft, The power output unit which is a means to control said 2nd connecting means so that connection between this revolving shaft and said driving shaft is canceled, while controlling said 1st connecting means so that said the 2nd revolving shaft and said output shaft of a motor are connected.
[Claim 15] Said connection control means is a power output unit according to claim 13 which is a means to control said the 1st connecting means and said 2nd connecting means so that this revolving shaft and said output shaft are connected, while said the 2nd revolving shaft and said driving shaft of a motor are connected.
[Claim 16] Said operational status is a power output unit according to claim 15 which is in the condition of predetermined within the limits which can operate this prime mover efficiently when the rotational frequency of said driving shaft is made into the rotational frequency of the output shaft of said prime mover.
[Claim 17] Said connection control means is a power output unit according to claim 13 which is a means to control said the 1st connecting means and said 2nd connecting means so that connection between this revolving shaft and said output shaft is canceled, while connection between the revolving shaft of said 2nd motor and said driving shaft is canceled.
[Claim 18] Said operational status is a power output unit according to claim 17 which is in the condition of predetermined within the limits which can operate this prime mover efficiently when the torque outputted to the condition in which an output is possible from said prime mover, without being accompanied by the change in the torque according the torque which should be outputted to a driving shaft to said 2nd motor is set up.
[Claim 19] Said operational status is a power output unit according to claim 17 which is in the condition which detected the abnormalities of said 2nd motor.
[Claim 20] A power output unit [ equipped with the drive control means which carries out drive control of said the 1st motor and said 2nd motor so that torque conversion of the power outputted from said prime mover may be carried out and it may output to said driving shaft, when the revolving shaft of said 2nd motor is connected to either said output shaft or said driving shaft by said connection control means ] according to claim 13.
[Claim 21] The charge and discharge of the power consumed or revived in claim 13 thru/or the case of an exchange of the power are the power output unit of a publication 20 either, and according to said 1st motor, The accumulation-of-electricity means in which the charge and discharge of the power consumed or revived in the case of an exchange of the power by said 2nd motor are possible, A target power setting means to set up the target power which should be outputted to said driving shaft based on directions of an operator, The target power set up by said target power setting means A power output unit equipped with the drive control means which carries out drive control of said prime mover, said 1st motor, and said 2nd motor so that it may be outputted to said driving shaft by the energy which consists of power by which charge and discharge are carried out with the power outputted from said prime mover, and said accumulation-of-electricity means.
[Claim 22] It is the power output unit which is a power output unit according to claim 21, and is the means which is equipped with an accumulation-of-electricity condition detection means to detect the condition of said accumulation-of-electricity means, and carries out drive control of said prime mover, said 1st motor, and said 2nd motor so that the condition of said accumulation-of-electricity means by which said drive control means was detected by said accumulation-of-electricity condition detection

means may be in the condition of predetermined within the limits.
[Claim 23] It is a power output unit according to claim 21. Said connection control means While controlling said 1st connecting means so that connection between the revolving shaft of said 2nd motor and said output shaft is canceled when there are predetermined directions of an operator, or when the target power set up by said target power setting means is the power of the predetermined range It is the power output unit which is the means which carries out drive control of said 2nd motor using the power with which it is a means to control said 2nd connecting means as this revolving shaft and said driving shaft are connected, and said drive control means discharges from said accumulation-of-electricity means.
[Claim 24] It is a power output unit according to claim 21. Said connection control means While controlling said 1st connecting means so that said the 2nd revolving shaft and said output shaft of a motor are connected when there are predetermined directions of an operator, or when the target power set up by said target power setting means is the power of the predetermined range It is a means to control said 2nd connecting means so that connection between this revolving shaft and said driving shaft is canceled. Said drive control means The power output unit which is a means to control said 2nd motor to negate the torque which acts on the output shaft of said prime mover with the output of this power while controlling this 1st motor using the power which discharges from said accumulation-of-electricity means to output power to a driving shaft from said 1st motor.
[Claim 25] It is a power output unit according to claim 21. Said connection control means While controlling said 1st connecting means so that said the 2nd revolving shaft and said output shaft of a motor are connected when there are predetermined directions of an operator, or when the target power set up by said target power setting means is the power of the predetermined range It is a means to control said 2nd connecting means so that this revolving shaft and said driving shaft are connected. Said drive control means The power output unit which is a means to control said 2nd motor to output power to said driving shaft, carrying out motoring of said prime mover using the power which discharges from said accumulation-of-electricity means while suspending the fuel supply to said prime mover, and control of ignition.
[Claim 26] The power output unit according to claim 25 equipped with the prime-mover starting control means which controls the fuel supply to this prime mover, and ignition in connection with motoring of said prime mover when predetermined starting directions are made.
[Claim 27] Said drive control means is a power output unit according to claim 26 which is a means to control said 2nd motor to negate the power outputted from this prime mover with starting of said prime mover by said prime-mover starting control means.
[Claim 28] There is no claim 21 which is a means to set up the power with which the output direction of shaft rotation of said prime mover makes the reverse sense rotate said driving shaft as target power, and said target power setting means is the power output unit of a publication 26 either.
[Claim 29] When it is a power output unit according to claim 13 and predetermined inversion directions are made, While controlling said the 1st and said 2nd connecting means so that connection between said revolving shaft of the 2nd motor and said output shaft is canceled and this revolving shaft and said driving shaft are connected through said connection control means A power output unit equipped with the inversion control means which controls this 2nd motor to output the power rotated to the reverse sense with the output direction of shaft rotation of said prime mover to said driving shaft from said 2nd motor.
[Claim 30] When it is a power output unit according to claim 13 and predetermined inversion directions are made, While controlling said the 1st and said 2nd connecting means so that said the 2nd revolving shaft and said output shaft of a motor are connected through said connection control means and connection between this revolving shaft and said driving shaft is canceled This 1st motor is controlled to output the power rotated to the reverse sense with the output direction of shaft rotation of said prime mover to said driving shaft from said 1st motor. A power output unit equipped with the inversion control means which controls said 2nd motor to negate the torque which acts on said output shaft as reaction force of the power outputted to this driving shaft.

[Claim 31] When it is a power output unit according to claim 13 and predetermined starting directions are made, While controlling said 1st and 2nd connecting means so that said the 2nd revolving shaft and said output shaft of a motor are connected through said connection control means and connection between this revolving shaft and said driving shaft is canceled A power output unit equipped with the prime-mover starting control means which controls said 2nd motor to carry out motoring of said prime mover, and controls the fuel supply to this prime mover, and ignition in connection with motoring of this prime mover.
[Claim 32] When it is a power output unit according to claim 13 and predetermined starting directions are made, While controlling said 1st and 2nd connecting means so that connection between the revolving shaft of said 2nd motor and said output shaft is canceled through said connection control means and this revolving shaft and said driving shaft are connected A power output unit equipped with the prime-mover starting control means which controls this 2nd motor so that this revolving shaft does not rotate, controls said 1st motor to carry out motoring of said prime mover, and controls the fuel supply to this prime mover, and ignition in connection with motoring of this prime mover further.
[Claim 33] Where it is a power output unit according to claim 13, connection between the revolving shaft of said 2nd motor and said output shaft was canceled and this revolving shaft and said driving shaft are connected, when outputting power to said driving shaft from said 2nd motor and predetermined starting directions are made, The power output unit equipped with the prime-mover starting control means which controls the fuel supply to this prime mover, and ignition in connection with motoring of this prime mover while controlling said 1st motor to carry out motoring of said prime mover.
[Claim 34] Said prime-mover starting means is a power output unit according to claim 33 which is a means to control said 2nd motor to negate the torque outputted to said driving shaft from said 1st motor as reaction force of the torque which motoring of said prime mover takes.
[Claim 35] It is a power output unit according to claim 13. Where said the 2nd revolving shaft and said output shaft of a motor were connected and connection between this revolving shaft and said driving shaft is canceled, while fixing said output shaft with said 2nd motor, when outputting power to said driving shaft from said 1st motor and predetermined starting directions are made, A power output unit equipped with the prime-mover starting control means which controls said 2nd motor to carry out motoring of said prime mover, and controls the fuel supply to this prime mover, and ignition in connection with motoring of this prime mover.
[Claim 36] Said prime-mover starting means is a power output unit according to claim 35 which is a means to control said 1st motor to negate the torque outputted to said driving shaft as reaction force of the torque which motoring of said prime mover takes.
[Claim 37] The prime mover which has an output shaft, the 1st shaft combined with said output shaft, and the 2nd shaft combined with said driving shaft, The power means of communication with which the power outputted and inputted by one residual shaft will be determined if the power which has the 3rd different shaft from this 1st shaft and the 2nd shaft, and is outputted and inputted by two shafts among these is determined, The 1st motor combined with said 3rd shaft, and the 2nd motor which has a different revolving shaft from said output shaft and said driving shaft, and exchanges power through this revolving shaft, The 1st connecting means which performs mechanical connection with said revolving shaft and said output shaft, and discharge of this connection, It is the control approach of the power output unit which is equipped with the 2nd connecting means which performs mechanical connection with said revolving shaft and said driving shaft, and discharge of this connection, and outputs power to said driving shaft. When the rotational speed of said output shaft is larger than the rotational speed of said driving shaft, Said 2nd connecting means is controlled so that this revolving shaft and said driving shaft are connected, while controlling said 1st connecting means so that connection between the revolving shaft of said 2nd motor and said output shaft is canceled. The control approach of the power output unit which controls said 2nd connecting means so that connection between this revolving shaft and said driving shaft is canceled, while controlling said 1st connecting means so that said revolving shaft and said output shaft are connected when the rotational speed of said output shaft is smaller than the rotational speed of said driving shaft.

[Claim 38] The prime mover which has an output shaft, the 1st shaft combined with said output shaft, and the 2nd shaft combined with said driving shaft, The power means of communication with which the power outputted and inputted by one residual shaft will be determined if the power which has the 3rd different shaft from this 1st shaft and the 2nd shaft, and is outputted and inputted by two shafts among these is determined, The 1st motor combined with said 3rd shaft, and the 2nd motor which has a different revolving shaft from said output shaft and said driving shaft, and exchanges power through this revolving shaft, The 1st connecting means which performs mechanical connection with said revolving shaft and said output shaft, and discharge of this connection, It has the 2nd connecting means which performs mechanical connection with said revolving shaft and said driving shaft, and discharge of this connection. If it is the control approach of the power output unit which outputs power to said driving shaft and the rotational frequency of said driving shaft is made into the rotational frequency of the output shaft of said prime mover, when this prime mover will be in the condition of predetermined within the limits which can be operated efficiently, The control approach of the power output unit which controls said the 1st connecting means and said 2nd connecting means so that this revolving shaft and said output shaft are connected, while said the 2nd revolving shaft and said driving shaft of a motor are connected.
[Claim 39] It is the control approach of a power output unit according to claim 37 or 38. Said power output unit The charge and discharge of the power consumed or revived in the case of an exchange of the power by said 1st motor, It has the accumulation-of-electricity means in which the charge and discharge of the power consumed or revived in the case of an exchange of the power by said 2nd motor are possible. The control approach of said power output unit Furthermore, the target power setting step which sets up the target power which should be outputted to said driving shaft based on directions of an operator, The set-up this target power It is the control approach to a power output unit equipped with the drive control step which carries out drive control of said prime mover, said 1st motor, and said 2nd motor so that it may be outputted to said driving shaft by the energy which consists of power by which charge and discharge are carried out with the power outputted from said prime mover, and said accumulation-of-electricity means.
[Claim 40] Said drive control step is the control approach of the power output unit according to claim 39 which is the step which carries out drive control of said prime mover, said 1st motor, and said 2nd motor so that the condition of said accumulation-of-electricity means may be detected and the condition of this accumulation-of-electricity means may be in the condition of predetermined within the limits.
[Claim 41] The prime mover which has an output shaft, the 1st shaft combined with said output shaft, and the 2nd shaft combined with said driving shaft, The power means of communication with which the power outputted and inputted by one residual shaft will be determined if the power which has the 3rd different shaft from this 1st shaft and the 2nd shaft, and is outputted and inputted by two shafts among these is determined, The 1st motor combined with said 3rd shaft, and the 2nd motor which has a different revolving shaft from said output shaft and said driving shaft, and exchanges power through this revolving shaft, The 1st connecting means which performs mechanical connection with said revolving shaft and said output shaft, and discharge of this connection, It has the 2nd connecting means which performs mechanical connection with said revolving shaft and said driving shaft, and discharge of this connection. Are the control approach of the power output unit which outputs power to said driving shaft, and this 1st connecting means and this 2nd connecting means are controlled to perform connection by said 1st connecting means, or connection by said 2nd connecting means. The control approach of the power output unit which carries out drive control of said the 1st motor and said 2nd motor so that torque conversion of the power outputted from said prime mover may be carried out and it may output to said driving shaft.

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DETAILED DESCRIPTION

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[Detailed Description of the Invention]
[0001]
[Field of the Invention] This invention relates to the power output unit which outputs efficiently the power outputted from a prime mover to a driving shaft, and its control approach in detail about a power output unit and its control approach.
[0002]
[Description of the Prior Art] Conventionally, as this kind of a power output unit, it is equipment carried in a car, and what combines the driving shaft combined with the output shaft of a prime mover and Rota of a motor electromagnetic with a magnetic coupling, and outputs the power of a prime mover to a driving shaft is proposed (for example, JP,53-133814,A etc.). In this power output unit, if transit of a car is started with a motor and the rotational frequency of a motor turns into a predetermined rotational frequency, while giving an exciting current to a magnetic coupling and carrying out cranking of the prime mover, the fuel supply and jump spark ignition to a prime mover will be performed, and a prime mover will be put into operation. After a prime mover starts, the power from a prime mover is outputted to a driving shaft by electromagnetic association of a magnetic coupling, and it is made to run a car. A motor is driven when power required for a driving shaft is insufficient, and it compensates this insufficiency with the power outputted to a driving shaft by the magnetic coupling. When the magnetic coupling is outputting power to the driving shaft, it revives the power according to slipping of the electromagnetic association. This revived power is stored in a dc-battery as power used in the case of initiation of transit, or is used as power of the motor with which the insufficiency of the power of a driving shaft is compensated.
[0003]
[Problem(s) to be Solved by the Invention] However, such a conventional power output unit had the problem of producing the case where the effectiveness of the whole equipment falls, when the rotational frequency of a driving shaft became large. In an above-mentioned power output unit, if it is going to output power to a driving shaft with a magnetic coupling even when the rotational frequency of a driving shaft becomes large, the rotational frequency of a prime mover must be carried out more than the rotational frequency of a driving shaft. since it usually comes out that the range has become settled by that rotational frequency and load torque and the field of the efficient operation point of a prime mover has it, while the driving shaft is rotating at the rotational frequency exceeding that range, the operation point efficient [ a prime mover ] will be out of range, and it must operate, consequently the effectiveness of the whole equipment will fall.
[0004] As one of the solutions to such a problem, these people replaced with the magnetic coupling in JP,9-308012,A, and have proposed the equipment using the planetary gear combined with the revolving shaft of a generator and this generator, the output shaft of a prime mover, and the driving shaft that has a motor. This outputs the power demanded by acting as the power running of the motor with which the driving shaft was equipped using this power after distributing the power outputted from a prime mover to two by planetary gear and changing the part into power with the generator from a driving shaft. When

the rotational frequency of a driving shaft becomes large, it carries out power running conversely, using a generator as a motor, the rotational frequency of a driving shaft is accelerated taking advantage of the property of planetary gear, and operation of a prime mover is enabled at a rotational frequency smaller than the rotational frequency of a driving shaft. Power required in order to act as the power running of the generator at this time is provided by operating a motor as a generator.
[0005] However, with the equipment of this proposal, when the rotational frequency of a driving shaft became larger than the rotational frequency of a prime mover, the technical problem that operation effectiveness will become low even if it is not comparable to conventional equipment occurred. When the rotational frequency of a driving shaft becomes larger than the rotational frequency of a prime mover as mentioned above, it acts as the power running of the generator using the power revived by the motor combined with ******. A part of power outputted to ****** from the generator is again revived as power by the motor. That is, a part of power circulates between a generator and a motor. Generally in conversion with mechanical power and power, the loss by the conversion efficiency of equipment arises. Therefore, existence of the circulating power which was mentioned above makes the operation effectiveness of equipment fall.
[0006] The power output unit and its control approach of this invention solve such a trouble, and set to one of the purposes to propose the control approach of the equipment which outputs more efficiently the power outputted from a prime mover to a driving shaft, and such equipment. Moreover, the power output unit and its control approach of this invention set to one of the purposes to propose the equipment which outputs power to a driving shaft efficiently, and the control approach of the equipment, even when the rotational frequency of a driving shaft becomes larger than the rotational frequency of a prime mover.
[0007]
[The means for solving a technical problem, and its operation and effectiveness] The power output unit of this invention provided the following means, in order to attain a part of above-mentioned purpose [ at least ].
[0008] The prime mover which the power output unit of this invention is a power output unit which outputs power to a driving shaft, and has an output shaft, The 1st shaft combined with said output shaft, and the 2nd shaft combined with said driving shaft, The power means of communication with which the power outputted and inputted by one residual shaft will be determined if the power which has the 3rd different shaft from this 1st shaft and the 2nd shaft, and is outputted and inputted by two shafts among these is determined, The 1st motor combined with said 3rd shaft, and the 2nd motor which has a different revolving shaft from said output shaft and said driving shaft, and exchanges power through this revolving shaft, Let it be a summary to have the 2nd connecting means which performs mechanical connection between the 1st connecting means which performs mechanical connection with said revolving shaft and said output shaft, and discharge of this connection, and said revolving shaft and said driving shaft, and discharge of this connection.
[0009] The power output unit of this invention can be connected to the output shaft of a prime mover, or can cancel the revolving shaft of the 2nd motor, and it can connect with a driving shaft or it can cancel it. Consequently, it can become possible to avoid that circulation of the power mentioned above arises, and the effectiveness of the whole equipment can be raised. The power output unit of this invention can take the operation mode which supplies the power revived with the 1st motor to the 2nd motor, and the operation mode which supplies the power regenerated with the 2nd motor to the 1st motor, when the 2nd motor is combined with the output shaft of a prime mover. Moreover, when the 2nd motor is combined with ******, two operation modes can be taken similarly. Thus, the power output unit of this invention can take a total of four operation modes. Therefore, it becomes possible to avoid circulation of power and to raise the effectiveness of the whole equipment by choosing the operation mode which circulation of power does not produce out of such operation modes.
[0010] In the power output unit of such this invention, it shall come for said the 1st connecting means and said 2nd connecting means to be constituted [ both ] by the clutch. If it carries out like this, each connecting means is realizable with a simple configuration.

[0011] Moreover, in the power output unit of this invention, a thing can also be carried out and it can also consider as the thing which comes to arrange said driving shaft and said output shaft on the same axle and which comes to arrange the revolving shaft of said 2nd motor on said driving shaft and said output shaft, and same axle further in this case. If it carries out like this, it can consider as arrangement advantageous to installing a power output unit in the tooth space formed on the straight line.
[0012] Moreover, a driving shaft, an output shaft, and the revolving shaft of the 2nd motor are set to the power output unit which it comes to arrange on the same axle. It shall come to arrange from said prime mover in order of said 2nd motor and said 1st motor, and shall come to arrange said the 1st connecting means and said 2nd connecting means between said 2nd motor and said 1st motor further in this case.
[0013] In the condition of having connected the 2nd motor to the driving shaft, since operation of a prime mover is suspended and it drives only using the power by the 2nd motor, generally the thing in which the bigger torque output of the 2nd motor than the 1st motor is possible is needed. Since the torque output of a motor is proportional to the die length of the shaft orientations of Rota and it is proportional to the square of a diameter, the magnitude of the 2nd motor becomes larger than the 1st motor. As for magnitude required to output the same energy on the other hand, when an internal combustion engine is used for a prime mover, the direction of a prime mover becomes larger than a motor. Therefore, if a prime mover, the 1st motor, and the 2nd motor are arranged in order of magnitude, it will become the order of a prime mover, the 2nd motor, and the 1st motor. By arranging in order of such magnitude, the handling at the time of there being a settlement and carrying a power output unit in a car, a ship, etc. and an installation tooth space can be made advantageous.
[0014] Moreover, since a clutch etc. can constitute the 1st connecting means and 2nd connecting means as mentioned above, as compared with the 1st motor and 2nd motor, the magnitude is small. Therefore, it can also become possible to arrange the 1st connecting means and 2nd connecting means to the dead space formed among these big devices, and it can also make the whole equipment compacter.
[0015] In addition, in the power output unit which it comes to arrange in order of a prime mover, the 2nd motor, and the 1st motor, various arrangement is possible for the 1st connecting means and 2nd connecting means. As the technique of arranging the 1st connecting means and 2nd connecting means collectively, you may arrange between the 2nd above-mentioned motor and the 1st motor, and may arrange between a prime mover and the 2nd motor. While considering as the technique of arranging the 1st connecting means and 2nd connecting means separately and arranging the 1st connecting means between a prime mover and the 2nd motor, it is good also as what is arranged between the 2nd motor and the 1st motor.
[0016] Moreover, in the power output unit which comes to arrange a driving shaft, an output shaft, and a revolving shaft on the same axle, it shall come to arrange from said prime mover in order of said 1st motor and said 2nd motor. Various things are mentioned as mentioned above also as the technique of arrangement of the 1st connecting means in this case, and the 2nd connecting means. Thus, arrangement of a prime mover, the 1st motor, and the 2nd motor and arrangement of the 1st connecting means and the 2nd connecting means can be defined by a scale, a tooth space to install of a power output unit, and can be considered as various arrangement.
[0017] Moreover, in the power output unit of this invention, it shall come to arrange the revolving shaft of said 2nd motor on a different shaft from said driving shaft and said output shaft. If it carries out like this, as compared with what makes the whole of each shaft a same axle top, the die length of the shaft orientations of equipment can be made small.
[0018] Furthermore, in the power output unit of this invention, it shall come to arrange said output shaft and said driving shaft on a different shaft. In this case, further, it shall come to arrange the revolving shaft of said 2nd motor on said output shaft and same axle, or shall come to arrange the revolving shaft of said 2nd motor on said driving shaft and same axle. These power output units can also make the die length of the shaft orientations of equipment small as compared with what makes the whole of each shaft a same axle top.
[0019] Moreover, in the power output unit of this invention, said 1st connecting means shall be equipped with a gear change means to change gears and to transmit the rotational frequency of the

revolving shaft of said 2nd motor to said output shaft, and said 2nd connecting means shall be equipped with the change gear which changes gears and transmits the rotational frequency of the revolving shaft of said 2nd motor to said driving shaft. If it carries out like this, the rotational frequency of a revolving shaft can be adjusted. Consequently, the 2nd motor can be operated on the more efficient point, and the effectiveness of equipment can be raised.

[0020] The power output units of this invention including these modifications shall be equipped with the connection control means which controls said the 1st connecting means and said 2nd connecting means based on the operational status of said prime mover, said 1st motor, said 2nd motor, and said driving shaft, or predetermined directions. If it carries out like this, the discharge can be performed in the connection list by the 1st connecting means and 2nd connecting means based on the condition of a prime mover, the 1st motor, the 2nd motor, and a driving shaft, or predetermined directions.

[0021] In the power output unit of this invention equipped with such a connection control means said connection control means When it is in the condition as said operational status that the rotational speed of said output shaft is larger than the rotational speed of said driving shaft, Said 2nd connecting means is controlled so that this revolving shaft and said driving shaft are connected, while controlling said 1st connecting means so that connection between the revolving shaft of said 2nd motor and said output shaft is canceled. When it is in the condition as said operational status that the rotational speed of said output shaft is smaller than the rotational speed of said driving shaft, While controlling said 1st connecting means so that said the 2nd revolving shaft and said output shaft of a motor are connected, it shall be a means to control said 2nd connecting means so that connection between this revolving shaft and said driving shaft is canceled.

[0022] When the 2nd motor is connected to a driving shaft, and the rotational speed of a driving shaft is larger than the rotational speed of the output shaft of a prime mover, it is easy to produce circulation of power. In the above-mentioned invention, since the connection condition of the 2nd motor is controllable according to the rotational speed of a driving shaft, and the rotational speed of an output shaft, circulation of power can be reduced and the effectiveness of the whole equipment can be raised.

[0023] Moreover, in the power output unit of this invention equipped with a connection control means, said connection control means shall be a means to control said the 1st connecting means and said 2nd connecting means so that this revolving shaft and said output shaft are connected while said revolving shaft and said driving shaft are connected. If it carries out like this, the output shaft and driving shaft of a prime mover can be rotated in one, and the power outputted from a prime mover can be outputted to a direct-drive shaft at a rotational frequency as it is.

[0024] In the power output unit of such a mode, said operational status shall be in the condition of predetermined within the limits which can operate this prime mover efficiently, when the rotational frequency of said driving shaft is made into the rotational frequency of the output shaft of said prime mover. If it carries out like this, the power outputted from the prime mover operated efficiently can be outputted to a direct-drive shaft at a rotational frequency as it is.

[0025] Furthermore, in the power output unit of this invention equipped with a connection control means, said connection control means shall be a means to control said the 1st connecting means and said 2nd connecting means so that connection between this revolving shaft and said output shaft is canceled while connection between the revolving shaft of said 2nd motor and said driving shaft is canceled. If it carries out like this, the 2nd motor can be put on the outside of the system which outputs power to a driving shaft.

[0026] In the power output unit of such a mode, said operational status shall be in the condition of predetermined within the limits which can operate this prime mover efficiently, when the torque outputted to the condition in which an output is possible from said prime mover, without being accompanied by the change in the torque according the torque which should be outputted to a driving shaft to said 2nd motor is set up. If it carries out like this, the power outputted from the prime mover operated efficiently can be outputted to a direct-drive shaft. Moreover, said operational status shall be in the condition which detected the abnormalities of said 2nd motor. If it carries out like this, when the abnormalities of the 2nd motor are detected, rotation of the 2nd motor can be suspended.

[0027] Or in the power output unit of this invention equipped with a connection control means, when said revolving shaft is connected to either said output shaft or said driving shaft by said connection control means, it shall have the drive control means which carries out drive control of said the 1st motor and said 2nd motor so that torque conversion of the power outputted from said prime mover may be carried out and it may output to said driving shaft. If it carries out like this, torque conversion can be carried out and it can output to the power of a request of the power outputted from the prime mover at a driving shaft. Consequently, if it is the operation point which outputs the same energy, a prime mover can be operated on the more efficient operation point, and the energy efficiency of the whole equipment can be raised.
[0028] Moreover, the charge and discharge of the power consumed or revived in the power output unit of this invention equipped with a connection control means in the case of an exchange of the power by said 1st motor, The accumulation-of-electricity means in which the charge and discharge of the power consumed or revived in the case of an exchange of the power by said 2nd motor are possible, A target power setting means to set up the target power which should be outputted to said driving shaft based on directions of an operator, The target power set up by said target power setting means It shall have the drive control means which carries out drive control of said prime mover, said 1st motor, and said 2nd motor so that it may be outputted to said driving shaft by the energy which consists of power by which charge and discharge are carried out with the power outputted from said prime mover, and said accumulation-of-electricity means.
[0029] The charge and discharge of the power consumed or revived in the case of an exchange of the power according [ an accumulation-of-electricity means ] to the 1st motor in the power output unit of this mode according to the need, The charge and discharge of the power consumed or revived in the case of an exchange of the power by the 2nd motor are performed. A drive control means with a target power setting means Drive control of a prime mover, the 1st motor, and the 2nd motor is carried out so that it may be outputted to a driving shaft by the energy which the target power set up as power which should be outputted to a driving shaft based on directions of an operator becomes from the power by which charge and discharge are carried out with the power outputted from a prime mover, and an accumulation-of-electricity means. Since torque conversion can be carried out and it can output to the power of a request of the energy which consists of power by which charge and discharge are carried out at a driving shaft with the power outputted from the power output unit, then prime mover of such a mode, and an accumulation-of-electricity means, even if bigger target power than the maximum power in which an output is possible is set up from a prime mover, this target power can be outputted to a driving shaft. For this reason, what can output only power smaller than the maximum target power which can be set up as a prime mover can be used. Consequently, the whole equipment can be miniaturized.
[0030] It has an accumulation-of-electricity condition detection means detect the condition of said accumulation-of-electricity means, and said drive control means shall be the means which carries out drive control of said prime mover, said 1st motor, and said 2nd motor so that the condition of said accumulation-of-electricity means detected by said accumulation-of-electricity condition detection means may be in the condition of predetermined within the limits in the power output unit of this invention equipped with such an accumulation-of-electricity means and a drive control means. Whenever it carries out like this, an accumulation-of-electricity means can be changed into the condition of predetermined within the limits.
[0031] In the power output unit of this invention equipped with an accumulation-of-electricity means and a drive control means moreover, said connection control means While controlling said 1st connecting means so that connection between the revolving shaft of said 2nd motor and said output shaft is canceled when there are predetermined directions of an operator, or when the target power set up by said target power setting means is the power of the predetermined range As this revolving shaft and said driving shaft are connected, it shall be a means to control said 2nd connecting means, and said drive control means shall be a means which carries out drive control of said 2nd motor using the power which discharges from said accumulation-of-electricity means. If it carries out like this, the rotation drive of

the driving shaft can be carried out only under the power outputted from the 2nd motor.
[0032] In the power output unit of this invention equipped with an accumulation-of-electricity means and a drive control means or said connection control means While controlling said 1st connecting means so that said the 2nd revolving shaft and said output shaft of a motor are connected when there are predetermined directions of an operator, or when the target power set up by said target power setting means is the power of the predetermined range It is a means to control said 2nd connecting means so that connection between this revolving shaft and said driving shaft is canceled. Said drive control means While controlling this 1st motor using the power which discharges from said accumulation-of-electricity means to output power to a driving shaft from said 1st motor It shall be a means to control said 2nd motor to negate the torque which acts on the output shaft of said prime mover with the output of this power. If it carries out like this, the rotation drive of the driving shaft can be carried out under the power outputted from the 1st motor.
[0033] In the power output unit of this invention equipped with an accumulation-of-electricity means and a drive control means furthermore, said connection control means While controlling said 1st connecting means so that said the 2nd revolving shaft and said output shaft of a motor are connected when there are predetermined directions of an operator, or when the target power set up by said target power setting means is the power of the predetermined range It is a means to control said 2nd connecting means so that this revolving shaft and said driving shaft are connected. Said drive control means While suspending the fuel supply to said prime mover, and control of ignition, and carrying out motoring of said prime mover using the power which discharges from said accumulation-of-electricity means, it shall be a means to control said 2nd motor to output power to said driving shaft. If it carries out like this, power can be outputted to a driving shaft with the 2nd motor, rotating a prime mover compulsorily.
[0034] In the power output unit of this invention of the mode which carries out motoring of this prime mover, when predetermined starting directions are made, it shall have the prime-mover starting control means which controls the fuel supply to this prime mover, and ignition in connection with motoring of said prime mover. If it carries out like this, a prime mover can be put into operation and it can shift to the mode which outputs power to a driving shaft from a prime mover and the 2nd motor easily.
[0035] And in the power output unit of this mode, said drive control means shall be a means to control said 2nd motor to negate the power outputted from this prime mover with starting of said prime mover by said prime-mover starting control means. If it carries out like this, fluctuation of the torque outputted to the driving shaft produced in the case of starting of a prime mover can be made small, or it can lose.
[0036] Moreover, in the power output unit of this invention equipped with an accumulation-of-electricity means and a drive control means, said target power setting means shall be a means to set up the power with which the output direction of shaft rotation of said prime mover makes the reverse sense rotate said driving shaft as target power. If it carries out like this, opposite orientation can be made to rotate a driving shaft with the output direction of shaft rotation of a prime mover.
[0037] Moreover, when predetermined inversion directions are made in the power output unit of this invention equipped with a connection control means, While controlling said the 1st and said 2nd connecting means so that connection between the revolving shaft of said 2nd motor and said output shaft is canceled through said connection control means and said revolving shaft and said driving shaft are connected It shall have the inversion control means which controls this 2nd motor to output the power rotated to the reverse sense with the output direction of shaft rotation of said prime mover to said driving shaft from said 2nd motor. If it carries out like this, the reverse sense can be made to rotate a driving shaft with the output direction of shaft rotation of a prime mover with the 2nd motor.
[0038] When predetermined inversion directions are made in the power output unit of this invention equipped with a connection control means, While controlling said the 1st and said 2nd connecting means so that said the 2nd revolving shaft and said output shaft of a motor are connected through said connection control means and connection between this revolving shaft and said driving shaft is canceled This 2nd motor is controlled to output the power rotated to the reverse sense with the output direction of shaft rotation of said prime mover to said driving shaft from said 1st motor. It shall have the inversion

control means which controls said 2nd motor to negate the torque which acts on said output shaft as reaction force of the power outputted to this driving shaft. If it carries out like this, the reverse sense can be made to rotate a driving shaft with the output direction of shaft rotation of a prime mover with the 1st motor.

[0039] When predetermined starting directions are made in the power output unit of this invention equipped with a connection control means, While controlling said 1st and 2nd connecting means so that said the 2nd revolving shaft and said output shaft of a motor are connected through said connection control means and connection between this revolving shaft and said driving shaft is canceled It shall have the prime-mover starting control means which controls said 2nd motor to carry out motoring of said prime mover, and controls the fuel supply to this prime mover, and ignition in connection with motoring of this prime mover. A prime mover can be put into operation with the 2nd motor, without establishing separately the motor for putting a prime mover into operation, if it carries out like this.

[0040] When predetermined starting directions are made in the power output unit of this invention equipped with a connection control means, While controlling said 1st and 2nd connecting means so that connection between the revolving shaft of said 2nd motor and said output shaft is canceled through said connection control means and this revolving shaft and said driving shaft are connected It shall have the prime-mover starting control means which controls this 2nd motor so that said revolving shaft does not rotate, controls said 1st motor to carry out motoring of said prime mover, and controls the fuel supply to this prime mover, and ignition in connection with motoring of this prime mover further. A prime mover can be put into operation with the 1st motor and 2nd motor, without establishing separately the motor for putting a prime mover into operation, if it carries out like this.

[0041] Where connection between the revolving shaft of said 2nd motor and said output shaft was canceled and this revolving shaft and said driving shaft are connected in the power output unit of this invention equipped with a connection control means, when outputting power to said driving shaft from said 2nd motor and predetermined starting directions are made, While controlling said 1st motor to carry out motoring of said prime mover, it shall have the prime-mover starting control means which controls the fuel supply to this prime mover, and ignition in connection with motoring of this prime mover. If it carries out like this, the midst which is driving the driving shaft with the 2nd motor can also put a prime mover into operation. From the first, it is not necessary to establish separately the motor for putting a prime mover into operation.

[0042] In the power output unit of this mode, said prime-mover starting means shall be a means to control said 2nd motor to negate the torque outputted to said driving shaft from said 1st motor as reaction force of the torque which motoring of said prime mover takes. If it carries out like this, torque fluctuation produced in a driving shaft can be made smaller.

[0043] In the power output unit of this invention equipped with a connection control means Where said the 2nd revolving shaft and said output shaft of a motor were connected and connection with said revolving shaft and said driving shaft is canceled, while fixing said output shaft with said 2nd motor, when outputting power to said driving shaft from said 1st motor and predetermined starting directions are made, It shall have the prime-mover starting control means which controls said 2nd motor to carry out motoring of said prime mover, and controls the fuel supply to this prime mover, and ignition in connection with motoring of this prime mover. If it carries out like this, the midst which is driving the driving shaft with the 1st motor can also put a prime mover into operation. From the first, it is not necessary to establish separately the motor for putting a prime mover into operation.

[0044] In the power output unit of this mode, said prime-mover starting means shall be a means to control said 1st motor to negate the torque outputted to said driving shaft as reaction force of the torque which motoring of said prime mover takes. If it carries out like this, torque fluctuation produced in a driving shaft can be made smaller.

[0045] The prime mover by which the control approach of the 1st power output unit of this invention has an output shaft, The 1st shaft combined with said output shaft, and the 2nd shaft combined with said driving shaft, The power means of communication with which the power outputted and inputted by one residual shaft will be determined if the power which has the 3rd different shaft from this 1st shaft and

the 2nd shaft, and is outputted and inputted by two shafts among these is determined, The 1st motor combined with said 3rd shaft, and the 2nd motor which has a different revolving shaft from said output shaft and said driving shaft, and exchanges power through this revolving shaft, The 1st connecting means which performs mechanical connection with said revolving shaft and said output shaft, and discharge of this connection, It is the control approach of the power output unit which is equipped with the 2nd connecting means which performs mechanical connection with said revolving shaft and said driving shaft, and discharge of this connection, and outputs power to said driving shaft. When the rotational speed of said output shaft is larger than the rotational speed of said driving shaft, Said 2nd connecting means is controlled so that this revolving shaft and said driving shaft are connected, while controlling said 1st connecting means so that connection between the revolving shaft of said 2nd motor and said output shaft is canceled. When the rotational speed of said output shaft is smaller than the rotational speed of said driving shaft, while controlling said 1st connecting means so that said revolving shaft and said output shaft are connected, let it be a summary to control said 2nd connecting means so that connection between this revolving shaft and said driving shaft is canceled.

[0046] The prime mover by which the control approach of the 2nd power output unit of this invention has an output shaft, The 1st shaft combined with said output shaft, and the 2nd shaft combined with said driving shaft, The power means of communication with which the power outputted and inputted by one residual shaft will be determined if the power which has the 3rd different shaft from this 1st shaft and the 2nd shaft, and is outputted and inputted by two shafts among these is determined, The 1st motor combined with said 3rd shaft, and the 2nd motor which has a different revolving shaft from said output shaft and said driving shaft, and exchanges power through this revolving shaft, The 1st connecting means which performs mechanical connection with said revolving shaft and said output shaft, and discharge of this connection, It has the 2nd connecting means which performs mechanical connection with said revolving shaft and said driving shaft, and discharge of this connection. If it is the control approach of the power output unit which outputs power to said driving shaft and the rotational frequency of said driving shaft is made into the rotational frequency of the output shaft of said prime mover, when this prime mover will be in the condition of predetermined within the limits which can be operated efficiently, While said the 2nd revolving shaft and said driving shaft of a motor are connected, let it be a summary to control said the 1st connecting means and said 2nd connecting means so that this revolving shaft and said output shaft are connected.

[0047] In the control approach of such 1st or 2nd power output unit said power output unit The charge and discharge of the power consumed or revived in the case of an exchange of the power by said 1st motor, It has the accumulation-of-electricity means in which the charge and discharge of the power consumed or revived in the case of an exchange of the power by said 2nd motor are possible. The control approach of said power output unit Furthermore, the target power setting step which sets up the target power which should be outputted to said driving shaft based on directions of an operator, The set-up this target power It shall have the drive control step which carries out drive control of said prime mover, said 1st motor, and said 2nd motor so that it may be outputted to said driving shaft by the energy which consists of power by which charge and discharge are carried out with the power outputted from said prime mover, and said accumulation-of-electricity means.

[0048] According to the control approach of this mode, since torque conversion can be carried out and it can output to the power of a request of the energy which consists of power by which charge and discharge are carried out at a driving shaft with the power outputted from a prime mover, and an accumulation-of-electricity means, even if bigger target power than the maximum power in which an output is possible is set up from a prime mover, this target power can be outputted to a driving shaft. For this reason, what can output only power smaller than the maximum target power which can be set up as a prime mover can be used. In such a control approach, said drive control step shall be a step which carries out drive control of said prime mover, said 1st motor, and said 2nd motor so that the condition of said accumulation-of-electricity means may be detected and the condition of this accumulation-of-electricity means may be in the condition of predetermined within the limits further. Whenever it carries out like this, an accumulation-of-electricity means can be changed into the condition of predetermined

within the limits.
[0049] The prime mover by which the control approach of the 3rd power output unit of this invention has an output shaft, The 1st shaft combined with said output shaft, and the 2nd shaft combined with said driving shaft, The power means of communication with which the power outputted and inputted by one residual shaft will be determined if the power which has the 3rd different shaft from this 1st shaft and the 2nd shaft, and is outputted and inputted by two shafts among these is determined, The 1st motor combined with said 3rd shaft, and the 2nd motor which has a different revolving shaft from said output shaft and said driving shaft, and exchanges power through this revolving shaft, The 1st connecting means which performs mechanical connection with said revolving shaft and said output shaft, and discharge of this connection, It has the 2nd connecting means which performs mechanical connection with said revolving shaft and said driving shaft, and discharge of this connection. Are the control approach of the power output unit which outputs power to said driving shaft, and this 1st connecting means and this 2nd connecting means are controlled to perform connection by said 1st connecting means, or connection by said 2nd connecting means. Let it be a summary to carry out drive control of said the 1st motor and said 2nd motor so that torque conversion of the power outputted from said prime mover may be carried out and it may output to said driving shaft.
[0050]
[Embodiment of the Invention] A. Explain the gestalt of operation of this invention based on an example below a configuration. Drawing 1 is the block diagram showing the outline configuration of the power output unit 20 as the 1st example of this invention. This car is equipped with the gasoline engine operated with a gasoline as an engine 50 which is a source of power so that it may illustrate. This engine 50 inhales the gaseous mixture of the air inhaled from the inhalation-of-air system, and the gasoline injected from the fuel injection valve 51 to a combustion chamber 52, and changes into rotation of a crankshaft 56 movement of the piston 54 depressed by explosion of this gaseous mixture. An ignition plug 62 forms a spark with the high voltage drawn through the distributor 60 from the ignitor 58, and gaseous mixture is lit by the spark and carries out explosion combustion of it by it.
[0051] Operation of this engine 50 is controlled by the electronic control unit (hereafter referred to as EFIECU) 70. The various sensors in which the operational status of an engine 50 is shown are connected to EFIECU70. For example, it is the rotational frequency sensor 76, the angle-of-rotation sensor 78, etc. which are prepared for the coolant temperature sensor and distributor 60 which detect the water temperature of the throttle-valve position sensor which detects the opening (position) of a throttle valve, the inlet-pipe negative pressure sensor which detects the load of an engine 50, and an engine 50, and detect the rotational frequency and angle of rotation of a crankshaft 56. In addition, although the starting switch 79 which detects the condition ST of an ignition key was connected to EFIECU70 in addition to this, illustration of other sensors, a switch, etc. was omitted.
[0052] The driving shaft 22 is combined with the crankshaft 56 of an engine 50 through the motors MG1 and MG2 and planetary-gear 220 grade which are mentioned later. The driving shaft 22 is combined with the differential gear 24, and, finally the torque from the power output unit 20 is transmitted to the driving wheels 26 and 28 on either side. These motors MG1 and MG2 are controlled by the control unit 80. Although the configuration of a control unit 80 is explained in full detail later, the interior is equipped with Control CPU and accelerator pedal position sensor 64a prepared in the shift position sensor 84 formed in the shift lever 82 or the accelerator pedal 64, brake-pedal position sensor 65a prepared in the brake pedal 65 are connected. Moreover, the control unit 80 is exchanging various information by EFIECU70 and the communication link which were mentioned above. About control including the exchange of such information, it mentions later.
[0053] The power output unit 20 consists of a motor MG 2 by which Rota 41 is mechanically connected to a crankshaft 56 or a driving shaft 22 by an engine 50, the planetary gear 200 combined with a motor MG 1, both, and a driving shaft 22, and the 1st clutch 45 and the 2nd clutch 46, and a control unit 80 which controls these operations.
[0054] Planetary gear 200 consist of planetary carriers 223 equipped with the PURANETARIPINI demon gear 223 which revolves around the sun while rotating between a ring wheel 222, and the sun

gear 221 and ring wheel 222 which it is arranged the sun gear 221 and sun gear 221 which rotate at the core, and concentric circular, and are rotated around a sun gear 221. The sun gear shaft 225 combined with the sun gear 221 is combined with Rota 31 of a motor MG 1. While being combined with a driving shaft 22 through the power extract gear 228 and the power transfer belt 229, Rota of a motor MG 2 and association with the 2nd clutch 46 are possible for the ring wheel shaft 227. While being combined with a crankshaft 45, Rota of a motor MG 2 and association with the 1st clutch 45 are possible for the planetary carrier shaft 226.
[0055] As shown in drawing 1 , a motor MG 1 equips the peripheral face of Rota 31 with eight permanent magnets, and is constituted as a synchronous motor which winds the coil of a three phase around 12 slots formed in the stator 33. The stator 33 and the body of Rota 31 consist of carrying out the laminating of the sheet metal of a non-oriented magnetic steel sheet, respectively. The permanent magnet stuck on Rota 31 is arranged so that N pole and the south pole may appear in a peripheral face by turns. If the three-phase alternating current is passed in the coil of a stator 33, rotating magnetic field will be produced. A motor MG 1 rotates by the interaction of this rotating magnetic field and the next time which the permanent magnet stuck on Rota 31 forms. Moreover, a motor MG 1 functions also as a generator which generates electricity using the electromotive force produced in the coil of a stator 33 by rotation of Rota 31.
[0056] The motor MG 2 consists of the stators 43 and Rota 42 which have the same configuration as a motor MG 1. It rotates by the interaction of the rotating magnetic field produced with the coil of a stator 43, and the field which the permanent magnet stuck on Rota 41 forms, and also a motor MG 2 functions as a generator. The revolving shaft of Rota 41 of a motor MG 2 is mechanically connected to a crankshaft 56 by the 1st clutch 45 arranged between planetary gear 200 and a motor MG 1, or the connection is canceled. Moreover, the 2nd clutch 46 connects with the ring wheel shaft 227 of planetary gear 200 mechanically, or the connection is canceled. In addition, the 1st clutch 45 and the 2nd clutch 46 operate by the hydraulic circuit which is not illustrated.
[0057] In addition, although not illustrated in drawing 1 , the resolver which detects angle-of-rotation thetad, thetar, and thetae is prepared in the driving shaft 22, the Rota revolving shaft 38, and the crankshaft 56. The resolver which detects angle-of-rotation thetae of a crankshaft 56 can also be used also [ sensor / 78 / which was prepared for the distributor 60 / angle-of-rotation ].
[0058] Although the arrangement used as a motor MG 2 and a motor MG 1 from an engine 50 side is also possible so that arrangement of motors MG1 and MG2 may be mentioned later Having arranged the motor MG 1 in the middle of an engine 50 and a motor MG 2 like the power output unit 20 of an example It is because there shall be a settlement by the power output unit 20 by making the big motor MG 2 adjoin the bigger engine 50 from the need of driving a car by the motor MG 2 so that it may mention later, since a motor MG 2 becomes large as compared with a motor MG 1. Moreover, various arrangement is possible so that arrangement of the 1st clutch 45 and the 2nd clutch 46 may also be mentioned later, but since both [ these ] the clutches 45 and 46 are comparatively small, it has arranged between a motor MG 1 and a motor MG 2 like the power output unit 20 of an example for putting into the clearance produced between a motor MG 1 and a motor MG 2, and making the power output unit 20 compacter.
[0059] Next, a control unit 80 is explained. A control unit 80 consists of control CPU 90 which carries out drive control of the 1st clutch 45 and the 2nd clutch 46, and a dc-battery 94 which is a rechargeable battery while controlling the 1st drive circuit 91 which drives a motor MG 1, the 2nd drive circuit 92 which drives a motor MG 2, and both the drive circuits 91 and 92. Control CPU 90 is one chip microprocessor, and although not illustrated, it equips the interior with RAM for work pieces, ROM which memorized the processing program, input/output port and EFIECU70, and the serial communication port that performs a communication link. Angle-of-rotation thetad of a driving shaft 22, angle-of-rotation thetar of Rota 41 of a motor MG 2, and angle-of-rotation thetae of an engine 50 are inputted into this control CPU 90 from each resolver. Moreover, the accelerator pedal position AP from accelerator pedal position sensor 64a (the amount of treading in of an accelerator pedal) The brake-pedal position BP from brake-pedal position sensor 65a (the amount of treading in of a brake pedal 65), The

on-off signal of both the clutches from the shift position SP, the 1st clutch 45, and the 2nd clutch 46 from the shift position sensor 84, The remaining capacity BRM from the remaining capacity detector 99 which detects the values Iuc and Ivc of the current which flows in the 1st drive circuit 91, the values Iua and Iva of the current which flows in the 2nd drive circuit, and the remaining capacity of a dc-battery 94 is inputted through input port. In addition, what the remaining capacity detector 99 measures the specific gravity of the electrolytic solution of a dc-battery 94 or the weight of the whole dc-battery 94, and detects remaining capacity, the thing which calculates the current value and time amount of charge and discharge, and detects remaining capacity, the thing which detects remaining capacity by acting as Short of between the terminals of a dc-battery momentarily, and measuring sink internal resistance for a current are known.

[0060] Moreover, from control CPU 90, the driving signal which drives the control signal which drives six transistors which are the switching elements prepared in the 1st drive circuit 91, the control signal which drives six as a switching element prepared in the 2nd drive circuit 92, the 1st clutch 45, and the 2nd clutch 46 is outputted. Six transistors in the 1st drive circuit 91 constitute the transistor inverter, and while two pieces are arranged at a time in a pair so that it may become a source and sink side to power-source Rhine of a pair, respectively, each of the three phase coil (UVW) of a motor MG 1 is connected at the node. Power-source Rhine is connected to the plus [ of a dc-battery 94 ], and minus side, respectively. The rate of the ON time amount of a transistor of making a pair by control CPU 90 is controlled sequentially, and if the current which flows in each coil is made into a false sine wave by PWM control, rotating magnetic field will be formed with a three phase coil. Six transistors of the 2nd drive circuit 92 also constitute the transistor inverter, and can form rotating magnetic field similarly.

[0061] B. Explain actuation of the power output unit 20 of the example which explained the configuration more than the principle of operation. In addition, the following explanation explains it, assuming the transmission efficiency of the power in equipment to be what is 100%. Fundamental actuation of planetary gear 200 is explained first. Although it is the thing of common knowledge on device study, planetary gear 200 have the property in which the power of one residual revolving shaft is determined, if the power of two revolving shafts is determined among three revolving shafts, the sun gear shaft 225, the ring wheel shaft 227, and the planetary carrier shaft 226. The rotational frequency of each revolving shaft and the relation of torque are shown by the degree type (1).

[0062]

Nr= (1+rho) Nc-rho Ns;
Nc=(Nr+rho Ns)/(1+rho);
Ns= (Nc-Nr) / rho+Nc;
Ts=rho / (1+rho) xTc;
Tr=1-/(1+rho) xTc -- (1)

[0063] Ns and Ts are the rotational frequencies and torque of the sun gear shaft 225, Nr and Tr are the rotational frequencies and torque of the ring wheel shaft 227 here, and Nc and Tc are the rotational frequencies and torque of the planetary carrier shaft 226. Moreover, rho is the gear ratio of a sun gear 221 and a ring wheel 222 as it is expressed with a degree type. The number of teeth of the number of teeth / ring wheel 222 of the rho= sun gear 221 [0064] The case (it is hereafter called undershirt drive association) where made the 1st clutch 45 off and the 2nd clutch 46 is set to ON, and the case (it is hereafter called overdrive association) where set the 1st clutch 45 to ON conversely, and the 2nd clutch 46 is made off are considered. the former is shown in the mimetic diagram of drawing 2 -- as -- a motor MG 2 -- a ring wheel 222 -- getting it blocked -- it is equivalent to the configuration attached in the driving shaft 22. The latter is equivalent to the configuration which attached the motor MG 2 in the crankshaft 56, as shown in the mimetic diagram of drawing 3 .

[0065] First, the former (when the 1st clutch 45 was made off and the 2nd clutch 46 is set to ON) actuation is explained. The principle of operation in this case, especially the principle of torque conversion are as follows. The situation of the torque conversion to drawing 4 is shown. An engine 50 shall be operated with the point Ne equivalent to P0 in drawing 4 , i.e., a rotational frequency, and Torque Te, and the point Nd1 equivalent to P1 in drawing 4 , i.e., a rotational frequency, and the power

which becomes torque Td1 shall be outputted from the driving shaft 22. It is referred to as Nd1 <Ne and Td1> Te. Moreover, the magnitude of power is both and let it be equals. That is, it considers as Nd1xTd1=NexTe.
[0066] When the ring wheel shaft 227 combined with the driving shaft 22 is rotating at the engine speed Nd1 and the power mentioned above from the engine 50 is outputted, the sun gear shaft 225 rotates with the engine speed Ns and Torque Ts which are searched for by the upper formula (1). Moreover, the torque Tr similarly searched for by the top formula (1) will be outputted from the ring wheel shaft 227. Naturally, Torque Tr is smaller than the torque Te outputted from an engine 50.
[0067] Since Rota 31 of a motor MG 1 is rotating by rotation of the sun gear shaft 225, if the control CPU 90 of a control device 80 outputs a control signal and switches the transistor of the drive circuit 91, a motor MG 1 will function as a generator. The power equivalent to NsxTs is revived by the motor MG 1. On the other hand, if power is supplied and it acts as the power running of the motor MG 2, torque can be added to the ring wheel shaft 227. If the electric energy supplied to a motor MG 2 is controlled, the torque equivalent to the difference of the torque Tr outputted to the ring wheel shaft 227 from an engine 50 and the torque Td1 which should be outputted from a driving shaft 22 can be added by the motor MG 2. under the present circumstances, the power which should be supplied to a motor MG 2 -- an upper type (1) and Nd1xTd1=NexTe -- based on relation, it is easily computable. The value becomes equal to power NsxTs revived by the motor MG 1.
[0068] That is, by supplying the power revived by the motor MG 1 to a motor MG 2, a rotational frequency and torque can be changed without changing the magnitude for the power outputted from the engine 50, and it can output from a driving shaft 22.
[0069] Next, an engine 50 is operated on the above-mentioned operation point P0, and the case where the power Nd2 which is equivalent to the point P2 in drawing 4 from a driving shaft 22, i.e., a bigger rotational frequency than a rotational frequency Ne, and the power which wears and consists of torque Td2 smaller than Torque Te are outputted is considered. In order to rotate the ring wheel shaft 227 at a rotational frequency higher than an engine 50 at this time, power is supplied to a motor MG 1, it will act as the power running of the motor MG 1, and it will be accelerated. On the other hand, the operation point P2 is enough if torque lower than the torque Te outputted from an engine 50 is outputted. As a result of acting as the power running of the motor MG 1 and accelerating rotation of the ring wheel shaft 227, from the ring wheel shaft 227, torque higher than the demand torque Td2 is outputted. Therefore, it generates electricity by the motor MG 2, and excessive torque is revived as power. This power is used for the power running of a motor MG 1. Like the case where the power which is equivalent to the point P1 from a driving shaft 22 is outputted, if an upper type (1) etc. is taken into consideration, the power revived by the motor MG 2 and the power supplied to a motor MG 1 are equal. Since a part of power outputted by the power running of a motor MG 1 is again revived by the motor MG 2, circulation of power will produce it at this time.
[0070] If the above actuation is summarized, in undershirt drive association, by carrying out regeneration operation of the motor MG 1 as the 1st operation mode, and carrying out power running of the motor MG 2, a rotational frequency can change into the low high condition of torque the power outputted from an engine 50, and the power output unit 20 can output it from a driving shaft 22. Moreover, by carrying out power running of the motor MG 1 as the 2nd operation mode, and carrying out regeneration operation of the motor MG 2, a rotational frequency can change into the low high condition of torque the power outputted from an engine 50, and can output it from a driving shaft 22. Circulation of power is not produced in the 1st operation mode, but circulation of power arises in the 2nd operation mode.
[0071] On the other hand, the principle of operation (principle of torque conversion) in overdrive association (mimetic diagram of drawing 3 ) is as follows. Now, the engine 50 is operated on the operation point P0 of a rotational frequency Ne and Torque Te, and suppose that it is rotating in the condition that a driving shaft 22 is equivalent to the point P1. If torque is outputted to a crankshaft 56 from the motor MG 2 attached in the crankshaft 56, the torque of the planetary carrier shaft 226 will turn into bigger torque than output-torque Te from an engine 50. If the magnitude of this addition torque is

controlled, it is controllable so that the magnitude of the torque outputted from the ring wheel shaft 227 based on an upper type (1) serves as the demand torque Td1. On the other hand, since a part of power inputted from the planetary carrier shaft 226 at this time is distributed by planetary gear 200 and it is transmitted to the sun gear shaft 225, it can revive this power as power by the motor MG 1. This power is used for the power running of a motor MG 2. Both power becomes equal like the case of undershirt drive association. Since a part of power outputted by the power running of a motor MG 2 is revived as power by the motor MG 1, circulation of power will have produced it at this time.

[0072] Next, an engine 50 is operated on the operation point P0, and the case where the power which is equivalent to the point P2 from a driving shaft 22 is outputted is considered. At this time, demand power is small compared with the power Te outputted from an engine 50. Therefore, regeneration operation of the motor MG 2 can be carried out, and the demand power Td2 can be outputted from the ring wheel shaft 227 by giving a load to the planetary carrier shaft 226. On the other hand, since the rotational frequency of the ring wheel shaft 227 is increased, it is necessary to act as the power running of the motor MG 1. The power revived by the motor MG 2 is used for the power running of a motor MG 1. Both power becomes equal like the case of undershirt drive association.

[0073] If the above actuation is summarized, as the 1st operation mode, by carrying out regeneration operation of the motor MG 1, and carrying out power running of the motor MG 2, a rotational frequency can change into the low high condition of torque the power outputted from an engine 50, and the power output unit 20 can output it from a driving shaft 22 in overdrive association. Moreover, by carrying out power running of the motor MG 1 as the 2nd operation mode, and carrying out regeneration operation of the motor MG 2, a rotational frequency can change into the low high condition of torque the power outputted from an engine 50, and can output it from a driving shaft 22. Circulation of power arises in the 1st operation mode, and circulation of power does not arise in the 2nd operation mode.

[0074] In addition, the power outputted from an engine 50 besides the actuation which the power output unit 20 carries out torque conversion of all the power outputted from the engine 50 explained above, and is outputted to a driving shaft 22 (product of Torque Te and a rotational frequency Ne), Various actuation, such as actuation which supplies the power which charges a dc-battery 94 or is insufficient in excessive power from a dc-battery 94, can also be carried out by adjusting the electrical energy revived or consumed by motors MG1 and MG2.

[0075] C. Explain a setup of operation-control (1) operation mode, next the operation control of the power output unit 20 constituted in this way based on the operation control routine illustrated to drawing 5 . An operation control routine is repeatedly performed for every (every [ for example, ] 8msec) predetermined time, after the directions which start transit of a car are made. If an operation control routine is performed, the control CPU 90 of a control unit 80 will perform processing which inputs the rotational frequency Nd of a driving shaft 22 first (step S100). It can ask for the engine speed Nd of a driving shaft 22 from angle-of-rotation thetad of the driving shaft 22 read from the resolver. Next, the accelerator pedal position AP detected by accelerator pedal position sensor 64a is read (step S102). Since an accelerator pedal 64 is broken in when it senses that an operator's output torque is insufficient, the accelerator pedal position AP corresponds to the output torque (namely, torque which should be outputted to a driving shaft 22) which the operator wants.

[0076] Then, processing which derives torque command value Td* which is the desired value of the torque which should be outputted to a driving shaft 22 based on the read accelerator pedal position AP and the rotational frequency Nd of a driving shaft 22 is performed (step S104). In the example, the map in which torque command value Td*, the engine speed Nd of a driving shaft 22, and relation with the accelerator pedal position AP are shown is beforehand memorized to ROM in control CPU 90, and if the accelerator pedal position AP is read, the value of torque command value Td* which corresponds at a map, and the read accelerator pedal position AP and the engine speed Nd of a driving shaft 22 shall be derived. An example of this map is shown in drawing 6 .

[0077] Next, the energy Pd which should be outputted to a driving shaft 22 from drawn torque command value Td* and the rotational frequency Nd of the read driving shaft 22 is searched for by count (Pd=Td*xNd) (step S106). Then, processing which reads the remaining capacity BRM of the dc-battery

94 detected by the remaining capacity detector 99 is performed, and judgment processing of operation mode is performed (step S110). Judgment processing of this operation mode is processed by the operation mode judging manipulation routine illustrated to drawing 7 . In an operation mode judging manipulation routine, the more suitable operation mode of the power output unit 20 at that time is judged using the data read by step S100 of an operation control routine thru/or S108, the calculated data. Here, explanation of the operation control routine of drawing 5 is once interrupted, and judgment processing of operation mode is previously explained based on the operation mode judging manipulation routine of drawing 7 .

[0078] If an operation mode judging manipulation routine is performed, it will judge it that the charge and discharge of a dc-battery 94 are required when it judges (step S130) and there is nothing within the limits of this whether there is control CPU 90 of a control device 80 within limits to which the remaining capacity BRM of a dc-battery 94 is expressed with a threshold BL and a threshold BH, and charge-and-discharge mode will be set up as operation mode of the power output unit 20 (step S132). Here, a threshold BL and a threshold BH show the lower limit and upper limit of remaining capacity BRM of a dc-battery 94, and a threshold BL is set up in the example as a value beyond electric energy required to carry out predetermined time continuation and perform drive by the motor MG 2 by the below-mentioned motor drive mode, addition of the power by the discharge power from the dc-battery 94 by power assistant mode, etc. Moreover, in case a threshold BH suspends the car which is usually in a run state from the remaining capacity BRM at the time of the full charge of a dc-battery 94, it is set below to the value which reduced the electric energy revived by the motor MG 1 and the motor MG 2.

[0079] When it is within limits to which the remaining capacity BRM of a dc-battery 94 is expressed with step S130 with a threshold BL and a threshold BH, it judges whether the energy Pd which should be outputted to a driving shaft 22 is over the maximum energy Pemax in which an output is possible from the engine 50 (step S134). When Energy Pd is over maximum energy Pemax, in maximum energy Pemax outputted from an engine 50, it judges that the energy running short needs to provide meals with the energy stored in the dc-battery 94, and power assistant mode is set up as operation mode of the power output unit 20 (step S136).

[0080] On the other hand, the energy Pd which should be outputted to a driving shaft 22 judges whether torque command value Td* and a rotational frequency Nd are within the limits of predetermined from an engine 50 at the time of below the maximum energy Pemax in which an output is possible (step S138), and sets up the direct-output mode in the condition of having set the 1st clutch 45 and the 2nd clutch 46 to ON as operation mode of the power output unit 20, at both the times of predetermined within the limits (step S140). Here, the predetermined range is range which can operate an engine 50 efficiently where both the clutches 45 and 46 are turned ON. It will be judged whether the operation point which specifically memorizes to ROM beforehand by using the proper range as a map controlling as direct-output mode among the operation points of an engine 50, and is expressed with torque command value Td* and a rotational frequency Nd is in this proper range. An example of the proper range at the time of controlling as direct-output mode of an engine 50 is shown in drawing 8 . Among drawing, Field PE is a field which can operate an engine 50, and Field PA is the proper range at the time of controlling as direct-output mode. In addition, this proper range PA is appointed by effectiveness, emission, etc. of an engine 50, and can be beforehand set up by experiment etc.

[0081] At step S138, when there are not torque command value Td* and the rotational frequency Nd of a driving shaft 22 within the limits of predetermined The energy Pd which should be outputted to a driving shaft 22 is smaller than the predetermined energy PML. And it judges whether the rotational frequency Nd of a driving shaft 22 is smaller than the predetermined rotational frequency NML (step S142), and both, when small, the motor drive mode of the drive by the motor MG 2 is set up as operation mode of the power output unit 20 (step S144). An engine 50 sets up the range based on effectiveness falling with low torque at a low engine speed, and the predetermined energy PML and the predetermined engine speed NML are set up as the energy Pd which serves as a field of under predetermined effectiveness as a operating range of an engine 50, and an engine speed Nd. In addition, a concrete value is defined with the property of an engine 50 etc. At step S142, Energy Pd is beyond the

predetermined energy PML, or it is judged as what performs the usual operation when a rotational frequency Nd is more than the predetermined rotational frequency NML, and operation mode is usually set up as operation mode of the power output unit 20 (step S146).
[0082] Return to step S110 of the operation control routine of drawing 5 , and it is based on the result of an operation mode judging manipulation routine. When operation mode is usually set up as operation mode, usually operation torque control processing (step S112) When charge-and-discharge mode is set up, charge-and-discharge torque control processing (step S114) When power assistant mode is set up, power assistant torque control processing (step S116) When direct-output mode is set up and motor drive mode is set up in direct-output torque control processing (step S118), motor driving torque control processing (step S120) is performed, respectively. In addition, it performs repeatedly for every (every [ for example, ] 4msec(s)) predetermined time to timing different separately [ the torque control routine of the operation mode set up when, as for each torque control processing, operation mode was set up by the operation mode judging manipulation routine, although the example indicated each / the convenience tops of illustration, and / these / torque control processing as a step of an operation control routine ] from an operation control routine independently from an operation control routine. Hereafter, each torque control processing is explained.
[0083] (2) Usually, operation torque control processing usual operation torque control processing (step S112 of drawing 5 ) is made by the usual operation torque control routine illustrated to drawing 9 and drawing 10 . If this routine is performed, the control CPU 90 of a control device 80 will perform processing which reads the engine speed Nd of a driving shaft 22, and the engine speed Ne of an engine 50 first (steps S150 and S152). It can also ask for the engine speed Ne of an engine 50 from angle-of-rotation thetae of the crankshaft 56 detected by the resolver prepared in the crankshaft 56, and it can also carry out direct detection also by the engine-speed sensor 76 prepared for the distributor 60. When using the rotational frequency sensor 76, the information on a rotational frequency Ne will be received from EFIECU70 connected to the rotational frequency sensor 76 by communication link. And the engine-speed difference Nc of both shafts is searched for by count (Nc=Ne-Nd) from the engine speed Nd of the driving shaft 22 read in this way, and the engine speed Ne of an engine 50 (step S154).
[0084] Then, the energy Pd calculated at step S106 of the operation control routine of drawing 5 is compared with the energy Pd (it is called the last energy Pd) used when this routine was started last time (step S156). Here, last time, the thing when performing just before [ when usual operation torque control processing of step S112 is continuously performed by the operation control routine of drawing 5 ] is said. When Energy Pd differs from the last energy Pd, target torque Te* of an engine 50, target rotational frequency Ne*, and torque command value Tc* of a motor MG 1 are set up by step S170 shown in drawing 10 thru/or processing of S188, and when the energy Pd of last time [ Energy / Pd ] is the same, torque command value Tc* of a motor MG 1 is set up by processing of steps S158 and S160 shown in drawing 10 . First, processing in case Energy Pd differs from the last energy Pd is explained, and processing when the same is explained after that.
[0085] When Energy Pd differs from the last energy Pd, processing which sets up target torque Te* of an engine 50 and target rotational frequency Ne* first based on the energy Pd which should be outputted to a driving shaft 22 is performed (step S170). Here, since the energy outputted from an engine 50 is equal to the product of the torque Te of an engine 50, and an engine speed Ne when all the energy Pd that should be outputted to a driving shaft 22 shall be supplied with an engine 50, the relation between target torque Te* of the output energy Pd and an engine 50 and target engine-speed Ne* becomes Pd=Te*xNe*. However, the combination of target torque Te* of an engine 50 and target rotational frequency Ne* which satisfy this relation exists innumerably. So, in an example, an engine 50 is operated in the condition that effectiveness is high as much as possible, to each energy Pd. And the combination of target torque Te* and target rotational frequency Ne* from which the operational status of an engine 50 changes smoothly to change of Energy Pd is searched for by experiment etc. This shall be beforehand memorized as a map to ROM, and the combination of target torque Te* and target rotational frequency Ne* corresponding to Energy Pd shall be derived from this map. This map is explained further.

[0086] Drawing 11 is a graph which shows the relation between the operation point of an engine 50, and the effectiveness of an engine 50. The curve B in drawing shows the boundary of the field which can operate an engine 50. it is like [ the field which can operate an engine 50 ] the curve alpha 1 which shows the operation point with the same effectiveness according to the property thru/or alpha 6 -- etc. -- an effectiveness line can be drawn. Moreover, the curve 1 with the fixed energy expressed with the product of Torque Te and a rotational frequency Ne, for example, curvilinear C1-C, and C3-C3 can be drawn on the field which can operate an engine 50. In this way, if the drawn energy Pe expresses the rotational frequency Ne of an engine 50 for the effectiveness of each operation point as an axis of abscissa along with fixed curvilinear C1-C1 thru/or C3-C3, it will become like the graph of drawing 12 .

[0087] But the effectiveness of an engine 50 differs greatly by on which operation point it operates with the same energy Pe outputted from an engine 50 so that it may illustrate. For example, on Ccurvilinear C1-1 with fixed energy, the effectiveness can be made the highest by operating an engine 50 on the operation point A1 (torque Te 1, rotational frequency Ne1). In curvilinear C2-C2 with the fixed energy Pe outputted, and C3-C3, the operation point with such highest effectiveness exists on each curve with fixed Energy Pe so that the operation point A2 and A3 may correspond, respectively. The curve A in drawing 11 is connected with the line which continues the operation point with which the effectiveness of an engine 50 becomes as high as possible to each energy Pe outputted from an engine 50 based on these. In the example, target torque Te* of an engine 50 and target engine-speed Ne* were set up using what used relation between each operation point on this curve A (Torque Te, engine speed Ne), and Energy Pe as the map.

[0088] Here, Curve A is connected with a continuous curve because the operational status of an engine 50 will change suddenly and it cannot shift to target operational status smoothly depending on extent of the change, but knocking may be produced or it may stop, when Energy Pe changes ranging over the discontinuous operation point if the operation point of an engine 50 is defined with a discontinuous curve to change of Energy Pe. Therefore, if Curve A is connected with a continuous curve in this way, each operation point on Curve A may not turn into the operation point with the highest effectiveness on a curve with fixed Energy Pe.

[0089] If target torque Te* of an engine 50 and target rotational frequency Ne* are set up, control CPU 90 compares set-up target rotational frequency Ne* with the rotational frequency Nd of a driving shaft 22 (step S172). Target rotational frequency Ne* and when larger than the rotational frequency Nd of a driving shaft 22 The 1st clutch 45 and the 2nd clutch 46 are operated so that the 1st clutch 45 may be off and the 2nd clutch 46 may serve as ON (configuration of the mimetic diagram of drawing 2 ) (step S174 thru/or S177). The torque computed by torque command value Tc* of a motor MG 1 by the top formula (1) based on target torque Te* of an engine 50 is set up (step S178). When it investigates whether actuation of the 1st clutch 45 and the 2nd clutch 46 is in the condition of detecting and setting up the condition of both the clutches 45 and 46, first (step S174) and is not in the condition of setting up, both the clutches 45 and 46 are both made off (step S176), and the 2nd clutch 46 is set to ON after that (step S177). Thus, both the clutches 45 and 46 are both [ once ] made off, because control of the motor MG2 grade at the time of clutch connection is easy. In addition, torque command value Tc* of a motor MG 1 will be set as load torque required in order to be stabilized and to operate an engine 50 on the operation point expressed with target torque Te* and target rotational frequency Ne*.

[0090] Target rotational frequency Ne* of an engine 50 at step S170 when smaller than the rotational frequency Nd of a driving shaft 22 By ON, the 1st clutch 45 operates the 1st clutch 45 and the 2nd clutch 46 so that the 2nd clutch 46 may serve as OFF (configuration of the mimetic diagram of drawing 3 ) (step S184 thru/or S187). The torque set up based on an upper type (1) after substituting for torque command value Td* which should be outputted to a driving shaft 22 at torque command value Tc* of a motor MG 1 is set up (step S188). Actuation of the 1st clutch 45 and the 2nd clutch 46 Target engine-speed Ne* detects the condition of both the clutches 45 and 46 first like the larger time than an engine speed Nd. When it investigates whether it is in the condition of setting up (step S184) and is not in the condition of setting up, both the clutches 45 and 46 are both made off (step S186), and the 1st clutch 45

is set to ON after that (step S187).
[0091] The reason for target rotational frequency Ne* of an engine 50 operating both the clutches 45 and 46 so that the power output unit 20 of an example may serve as undershirt drive association (refer to drawing 2 ), when larger than the rotational frequency Nd of a driving shaft 22, and operating both the clutches 45 and 46 here so that target rotational frequency Ne* may become overdrive association (refer to drawing 3 ), when smaller than a rotational frequency Nd is as follows. In undershirt drive association, circulation of power does not arise in the 1st operation mode which changes and outputs the power outputted from an engine 50 to power with a more low rotational frequency as already explained. Conversely, in overdrive association, circulation of power does not arise in the 2nd operation mode which changes and outputs the power outputted from an engine 50 to power with a more high rotational frequency. Therefore, if in the undershirt drive with the engine speed Nd of a driving shaft 22 lower than target engine-speed Ne* of an engine 50 clutches 45 and 46 are operated so that undershirt drive association may be realized, and it operates it so that overdrive association may be realized in being reverse, operation effectiveness of the power output unit 20 can be made high. Actuation of the clutch mentioned above is based on this reason.
[0092] On the other hand, rotational frequency deflection **Ne is computed by subtracting a rotational frequency Ne from target rotational frequency Ne* of an engine 50 at step S156, when Energy Pd is the same as the last energy Pd (step S158). And Tc* is computed by the degree type (2) using computed rotational frequency deflection **Ne, and the computed value is set up as torque command value Tc* of a motor MG 1 (step S160). The 2nd term of the right-hand side in a formula (2) is a proportional which negates the deflection from target rotational frequency Ne* of a rotational frequency Ne here, and the 3rd term of the right-hand side is an integral term for abolishing steady-state deviation. Therefore, as for torque command value Tc* of a motor MG 1, the last torque command value Tc* will be set up by the steady state (when rotation deflection **Ne from target rotational frequency Ne* of a rotational frequency Ne is a value 0). In addition, Kc1 and Kc2 in a formula (2) are a proportionality constant. Thus, by setting up torque command value Tc* of a motor MG 1, an engine 50 can be stabilized on the operation point of target torque Te* and target rotational frequency Ne*.
[0093]
[Equation 1]
$$Tc^* \leftarrow \text{前回}Tc^* + Kc1\Delta Ne + Kc2\int \Delta Ne dt \qquad \cdots\cdots(2)$$

[0094] Next, the torque outputted from a driving shaft 22 according to torque command value Tc* of a motor MG 1 is computed based on an upper type (1). And torque command value Ta* of a motor MG 2 is set up so that demand torque may be outputted from a driving shaft (step S164).
[0095] In this way, a setup of torque command value Tc* of target torque Te* of an engine 50, target rotational frequency Ne*, a motor MG 1, and a motor MG 2 and Ta* performs control of a motor MG 1, a motor MG 2, and an engine 50 so that a motor MG 1, a motor MG 2, and an engine 50 may operate with each set-up set point (step S166 thru/or S169). although the example indicated each control of a motor MG 1, a motor MG 2, and an engine 50 as a separate step of this routine on account of illustration, these control is separate from this routine in fact -- it is carried out independently and synthetically. For example, while control CPU 90 is parallel control of a motor MG 1 and a motor MG 2 and performs [ control ] to different timing from this routine using interruption processing, it is made to carry out by transmitting directions to EFIECU70 by communication link, and control of an engine 50 being parallel with EFIECU70.
[0096] Control (step S162 of drawing 9 ) of a motor MG 1 is made by the clutch motor control routine illustrated to drawing 13 . If this routine is performed, the control CPU 90 of a control device 80 will perform first processing which inputs angle-of-rotation thetad of the revolving shaft of Rota 31 from a resolver (step S190), and will perform processing which asks for electrical angle thetac of a motor MG 1 from angle-of-rotation thetad of both shafts (step S194). In the example, since the synchronous motor of four pole pairs is used as a motor MG 1, thetac=4thetad will be calculated.

[0097] Next, processing which detects the currents Iuc and Ivc which are flowing to U phase and V phase of a three phase coil of a motor MG 1 with the current detectors 95 and 96 is performed (step S196). Although the current is flowing to the three phase of U, V, and W, since the total is zero, it is sufficient if the current which flows to two phases is measured. In this way, coordinate transformation (a three phase circuit/2 phase-number conversion) is performed using the current of the obtained three phase (step S198). Coordinate transformation is changing into the current value of d shaft of the synchronous motor of a permanent-magnet type, and q shaft, and is performed by calculating a degree type (3). Coordinate transformation is performed in the synchronous motor of a permanent-magnet type here because it is an amount with the current of d shaft and q shaft essential when controlling torque. It is also possible to control from the first with a three phase.
[0098]
[Equation 2]

$$\begin{bmatrix} Idc \\ Iqc \end{bmatrix} = \sqrt{2} \begin{bmatrix} -\sin(\theta c - 120) & \sin\theta c \\ -\cos(\theta c - 120) & \cos\theta c \end{bmatrix} \begin{bmatrix} Iuc \\ Ivc \end{bmatrix} \quad \cdots\cdots(3)$$

[0099] Next, after changing into a biaxial current value, processing which asks for current command value Idc* of each shaft searched for from torque command value Tc* in a motor MG 1, Iqc*, the currents Idc and Iqc that actually flowed on each shaft, and deflection, and calculates the electrical-potential-difference command values Vdc and Vqc of each shaft is performed (step S200). That is, the following formulas (4) are calculated first and then a degree type (5) is calculated. Here, Kp 1 and 2 and Ki 1 and 2 are multipliers respectively. These multipliers are adjusted so that the property of the motor to apply may be suited. In addition, the electrical-potential-difference command values Vdc and Vqc are calculated from the part (the 1st term of the formula (5) right-hand side) proportional to deflection **I with current command value I*, and an accumulated part (the 2nd term of the right-hand side) of the past of i batch of deflection **I.
[0100]
[Equation 3]

$$\begin{aligned} \Delta Idc &= Idc^* - Idc \\ \Delta Iqc &= Iqc^* - Iqc \end{aligned} \quad \cdots\cdots(4)$$

[0101]
[Equation 4]

$$\begin{aligned} Vdc &= Kp1 \cdot \Delta Idc + \sum Ki1 \cdot \Delta Idc \\ Vqc &= Kp2 \cdot \Delta Iqc + \sum Ki2 \cdot \Delta Iqc \end{aligned} \quad \cdots\cdots(5)$$

[0102] Then, coordinate transformation (2 phases / three-phase-circuit conversion) equivalent to the inverse transformation of the conversion which performed the electrical-potential-difference command value calculated in this way at step S198 is performed (step S202), and processing which asks for the electrical potential differences Vuc, Vvc, and Vwc actually impressed to a three phase coil is performed. It asks for each electrical potential difference by the degree type (6).
[0103]
[Equation 5]

$$\begin{bmatrix} Vuc \\ Vvc \end{bmatrix} = \sqrt{\frac{2}{3}} \begin{bmatrix} \cos\theta c & -\sin\theta c \\ \cos(\theta c - 120) & -\sin(\theta c - 120) \end{bmatrix} \begin{bmatrix} Vdc \\ Vqc \end{bmatrix}$$
$$Vwc = -Vuc - Vvc \quad \cdots\cdots(6)$$

[0104] Since actual armature-voltage control is made by the on-off time amount of the transistor of the 1st drive circuit 91, it carries out PWM control of the ON time amount of each transistor so that it may become each electrical-potential-difference command value calculated by the formula (6) (step S204).

Control (step S168 of drawing 9 ) of a motor MG 2 is also the same processing.
[0105] Next, control (step S169 of drawing 9 ) of an engine 50 is explained. Torque Te and a rotational frequency Ne are controlled so that an engine 50 will be in a steady operation condition on the operation point of target torque Te* set up in step S170 of drawing 10 , and target rotational frequency Ne*. Specifically so that an engine 50 may be operated on the operation point of target torque Te* and target rotational frequency Ne* While EFIECU70 which received target torque Te* and target engine-speed Ne* by communication link from control CPU 90 performs opening control of a throttle valve, fuel-injection control from a fuel injection valve 51, and ignition control by the ignition plug 62 The torque Tc of the motor MG 1 as load torque of an engine 50 is controlled by the control CPU 90 of a control device 80. It is because control of the torque Tc of the motor MG 1 which cannot operate an engine 50 only by control by EFIECU70 on the operation point of target torque Te* and target rotational frequency Ne* since output-torque Te and a rotational frequency Ne change with the load torque, but gives load torque is also needed. In addition, control of the motor MG 1 mentioned above explained control of the torque Tc of a motor MG 1.
[0106] the thing which were explained above and which is usually considered as undershirt drive association (configuration of the mimetic diagram of drawing 2 ) according to operation torque control processing when the engine speed Ne of an engine 50 is larger than the engine speed Nd of a driving shaft 22 -- circulation of power -- decreasing -- the power output unit 20 -- energy efficiency can be made high as a whole. moreover, the thing considered as overdrive association (configuration of the mimetic diagram of drawing 3 ) when the engine speed Ne of an engine 50 is smaller than the engine speed Nd of a driving shaft 22 -- too -- circulation of power -- decreasing -- the power output unit 20 -- energy efficiency can be made high as a whole. Therefore, as compared with the case where it fixes to the configuration of the mimetic diagram of drawing 2 or drawing 3 , energy efficiency can be made high.
[0107] Moreover, since it will be set up so that an engine 50 may serve as the highest possible effectiveness if the energy Pe which is outputted from an engine 50 in target torque Te* of an engine 50 and target engine-speed Ne* according to operation torque control processing is usually the same, energy efficiency as the power output unit 20 whole can be made higher. Moreover, if the effectiveness Ksc and Ksa of a motor MG 1 and a motor MG 2 is considered to be a value 1, torque conversion can be carried out and the power with which it is expressed by target torque Te* and target rotational frequency Ne* which are outputted from an engine 50 can be outputted to the power with which it is expressed by a motor MG 1 and the motor MG 2 at torque command value Td* and a rotational frequency Nd at a driving shaft 22. And since target torque Te* of an engine 50 and target rotational frequency Ne* are defined based on this torque command value Td* according to the amount of treading in of the accelerator pedal 64 by the operator, the torque (torque command value Td*) which should be outputted to a driving shaft 22 can output the power of a request of an operator to a driving shaft 22.
[0108] (3) Explain charge-and-discharge torque control processing, next charge-and-discharge torque control processing (step S114 of drawing 5 ) based on drawing 14 and the charge-and-discharge torque control routine of drawing 15 . As mentioned above, it is out of range, and charge-and-discharge mode is set up and this routine is performed, when [ at which the remaining capacity BRM of a dc-battery 94 is expressed with steps S130 and S132 of drawing 7 with a threshold BL and a threshold BH ] it is judged that the charge and discharge of a dc-battery 94 are required.
[0109] If this routine is performed, control CPU 90 measures the remaining capacity BRM of a dc-battery 94 with a threshold BL and a threshold BH first (step S220). Step S130 of drawing 7 explained the threshold BL and the threshold BH. When the remaining capacity BRM of a dc-battery 94 is under the threshold BL Judge that a dc-battery 94 needs to be charged and processing (step S222 thru/or S228) which sets up the energy Pd in consideration of energy (charge energy Pbi) required to charge a dc-battery 94 is performed. When the remaining capacity BRM of a dc-battery 94 is larger than a threshold BH, it judges that a dc-battery 94 needs to be discharged, and processing (step S232 thru/or S238) which sets up the energy Pd in consideration of the energy (charge energy Pbo) which discharges from a dc-battery 94 is performed.

[0110] In the processing (step S222 thru/or 228) which sets up the energy Pd in consideration of the charge energy Pbi required to charge a dc-battery 94, the control CPU 90 of a control device 80 performs first processing which sets up the charge energy Pbi based on the remaining capacity BRM of a dc-battery 94 (step S222). Thus, it is because the power (energy) which setting up the charge energy Pbi based on the remaining capacity BRM of a dc-battery 94 can charge [ of a dc-battery 94 ] changes with remaining capacity BRM and also changes a proper charge electrical potential difference and the proper charging current by remaining capacity BRM. An example of the relation between the remaining capacity BRM of a dc-battery 94 and the power which can be charged is shown in drawing 16 . In addition, in the example, the optimal charge energy Pbi shall be searched for by experiment etc. from each remaining capacity BRM of a dc-battery 94, it shall be beforehand memorized as a map to ROM, and the charge energy Pbi corresponding to the remaining capacity BRM of a dc-battery 94 shall be derived. Then, the charge energy Pbi drawn to the energy Pd which should be outputted to a driving shaft 22 is added, and Energy Pd is reset (step S224). And it investigates whether the energy Pd which it reset is over the maximum energy Pemax in which an output is possible from the engine 50 (step S226), and when having exceeded, maximum energy Pemax is set as Energy Pd as processing which restricts Energy Pd to maximum energy Pemax (step S228).

[0111] In the processing (step S232 thru/or S238) which sets up the energy Pd in consideration of energy (charge energy Pbo) required to discharge a dc-battery 94, the control CPU 90 of a control device 80 performs first processing which sets up spark discharge energy Pbo based on the remaining capacity BRM of a dc-battery 94 (step S232). Thus, based on the remaining capacity BRM of a dc-battery 94, spark discharge energy Pbo is set up because the power (energy) which can discharge a dc-battery 94 may change with remaining capacity BRM. In the example, the optimal discharge energy Pbo shall be searched for by experiment etc. from each remaining capacity BRM of the used dc-battery 94, it shall be beforehand memorized as a map (not shown) to ROM, and the spark discharge energy Pbo corresponding to the remaining capacity BRM of a dc-battery 94 shall be derived. Then, the spark discharge energy Pbo drawn from the energy Pd which should be outputted to a driving shaft 22 is reduced, and Energy Pd is reset (step S234). And the energy Pd which it reset investigates whether it is under threshold energy Pemin in which an output is possible from an engine 50 (step S236), and sets threshold energy Pemin as Energy Pd as processing which restricts Energy Pd to threshold energy Pemin at the case of under threshold energy Pemin (step S218).

[0112] Thus, resetting of the energy Pd which should be outputted to a driving shaft 22 in consideration of the charge energy Pbi or spark discharge energy Pbo sets up target torque Te* of an engine 50, and target rotational frequency Ne* based on this energy Pd that it reset (step S240). Setting processing of this target torque Te* and target rotational frequency Ne* is the same as processing of step S170 of drawing 10 .

[0113] Next, processing which reads the engine speed Nd of a driving shaft 22 is performed (step S242), and target engine-speed Ne* of the set-up engine 50 is compared with the engine speed Nd of the read driving shaft 22 (step S244). And the 1st clutch 45 and the 2nd clutch 46 are operated so that the 1st clutch 45 has off target engine-speed Ne* of an engine 50 when larger than the engine speed Nd of a driving shaft 22, and the 2nd clutch 46 may serve as ON (configuration of the mimetic diagram of drawing 2 ) (step S250 thru/or S254). The processing (step S250 thru/or processing of S254) which operates the 1st clutch 45 and the 2nd clutch 46 so that it may become the configuration of the mimetic diagram of drawing 2 about the power output unit 20 of an example is the same as the step [ in / including the reason for both / once / making both the clutches 45 and 46 off / drawing 9 and the usual operation torque control routine of drawing 10 ] S174 thru/or processing of S177, when it will be in the condition that both the clutches 45 and 46 are going to set up.

[0114] On the other hand, by ON, when smaller than the engine speed Nd of a driving shaft 22, the 1st clutch 45 operates [ target engine-speed Ne* which is an engine 50 / the 2nd clutch 46 ] the 1st clutch 45 and the 2nd clutch 46 so that OFF (configuration of the mimetic diagram of drawing 3 ) may come (step S260 thru/or S264). In addition, the processing (step S250 thru/or processing of S254) which operates the 1st clutch 45 and the 2nd clutch 46 so that it may become the configuration of the mimetic diagram

of drawing 3 about the power output unit 20 of an example When it will be in the condition that both the clutches 45 and 46 are going to set up, it is the same as that of the step [ in / including the reason for both / once / making both the clutches 45 and 46 off / drawing 9 and the usual operation torque control routine of drawing 10 ] S184 thru/or processing of S187.

[0115] After connecting a clutch, torque command value Tc* of a motor MG 1 is set up so that target torque Te* of an engine 50 may be realized (step S266), and torque command value Ta* of a motor MG 2 is set up so that torque command value Td* which should be outputted to a driving shaft 22 may be attained (step S268). These values are computed based on an upper type (1).

[0116] Thus, if torque command value Tc* of a motor MG 1 and torque command value Ta* of a motor MG 2 are set up while operating both the clutches 45 and 46 according to the engine speed Nd of target engine-speed Ne* of an engine 50, and a driving shaft 22, each control of a motor MG 1, a motor MG 2, and an engine 50 will be performed using these set-up set points (step S270 thru/or S274). Since these the control of each is the same as each control of step S166 thru/or S169 in drawing 9 and the usual operation torque control routine of drawing 10 , explanation here is omitted. In addition, although each control of such a motor MG 1, a motor MG 2, and an engine 50 is performed also in each routine of other torque control processings, since it is the same as that of each control of step S166 thru/or S169 in drawing 9 and the usual operation torque control routine of drawing 10 unless it indicates especially, the explanation is omitted.

[0117] Next, signs that it discharges from signs that a dc-battery 94 is charged by such charge-and-discharge torque control processing, and a dc-battery 94 are explained. At step S220, when the remaining capacity BRM of a dc-battery 94 is smaller than a threshold BL, the charge energy Pbi is added to Energy Pd, it resets Energy Pd, and target torque Te* of an engine 50 and target rotational frequency Ne* are set up based on this energy Pd that it reset. On the other hand, irrespective of target rotational frequency Ne* of an engine 50, and the rotational frequency Nd of a driving shaft 22, torque command value Tc* of a motor MG 1 and torque command value Ta* of a motor MG 2 are set up so that torque command value Td* may be outputted to a driving shaft 22. For this reason, the energy Pe outputted from an engine 50 becomes larger than the energy Pd outputted to a driving shaft 22. consequently, at the time of the configuration of target rotational frequency Ne* of an engine 50 of the mimetic diagram of drawing 2 smaller than the rotational frequency Nd of a driving shaft 22 The power revived by the motor MG 1 becomes larger than the power consumed by the motor MG 2. The power revived by the motor MG 2 becomes larger than the power consumed by the motor MG 1, and dump power will arise also in the time of the configuration of which mimetic diagram at the time of the configuration of target rotational frequency Ne* of an engine 50 of the mimetic diagram of bigger drawing 3 than the rotational frequency Nd of a driving shaft 22. In the example, a dc-battery 94 is charged by this dump power.

[0118] On the other hand, at step S220, when the remaining capacity BRM of a dc-battery 94 is bigger than a threshold BL, spark discharge energy Pbo is subtracted from Energy Pd, it resets Energy Pd, and target torque Te* of an engine 50 and target rotational frequency Ne* are set up based on this energy Pd that it reset. On the other hand, irrespective of target rotational frequency Ne* of an engine 50, and the rotational frequency Nd of a driving shaft 22, torque command value Tc* of a motor MG 1 and torque command value Ta* of a motor MG 2 are set up so that torque command value Td* may be outputted to a driving shaft 22. For this reason, the energy Pe outputted from an engine 50 becomes smaller than the energy Pd outputted to a driving shaft 22. consequently, at the time of the configuration of target rotational frequency Ne* of an engine 50 of the mimetic diagram of drawing 2 smaller than the rotational frequency Nd of a driving shaft 22 The power revived by the motor MG 1 becomes smaller than the power consumed by the motor MG 2. At the time of the configuration of target rotational frequency Ne* of an engine 50 of the mimetic diagram of bigger drawing 3 than the rotational frequency Nd of a driving shaft 22, the power revived by the motor MG 2 becomes smaller than the power consumed by the motor MG 1, and power will be insufficient also in the time of the configuration of which mimetic diagram. This insufficient power is provided with the discharge from a dc-battery 94 in the example.

[0119] According to charge-and-discharge torque control processing in which it explained above, remaining capacity BRM of a dc-battery 94 can be made into the range of desired. Consequently, the overdischarge and overcharge of a dc-battery 94 are avoidable. And energy conversion of the power by which charge and discharge are carried out to the energy Pe outputted from an engine 50 with a dc-battery 94 can be carried out, and it can output to a driving shaft 22 as desired power. By operating the 1st clutch 45 and the 2nd clutch 46 based on the engine speed Ne of an engine 50, and the engine speed Nd of a driving shaft 22, and considering as the configuration of the mimetic diagram of drawing 2 , or the configuration of the mimetic diagram of drawing 3 from the first, the energy loss by the motor MG 1 and the motor MG 2 can be made small, and energy efficiency can be made high as the whole equipment. Moreover, if the operation point of an engine 50 is the operation point which outputs the set-up energy Pd, since it is good as any operation points, it can operate an engine 50 on the more efficient operation point. Consequently, energy efficiency of the whole equipment can be made higher.
[0120] In addition, although the charge energy Pbi and spark discharge energy Pbo were set up in the power output unit 20 of an example based on the remaining capacity BRM of a dc-battery 94, it is good also as a predetermined value which defined beforehand the charge energy Pbi and spark discharge energy Pbo.
[0121] (4) Explain power assistant torque control processing, next power assistant torque control processing (step S116 of drawing 5 ) based on the power assistant torque control routine of drawing 17 . This routine is performed when the energy Pd which should be outputted to a driving shaft 22 at steps S134 and S136 of drawing 7 is over the maximum energy Pemax in which an output is possible from the engine 50.
[0122] If this routine is performed, the control CPU 90 of a control device 80 will perform processing which sets up target torque Te* of an engine 50, and target rotational frequency Ne* first based on the maximum energy Pemax in which an output is possible from an engine 50 (step S280). Thus, since the energy Pd which should be outputted to a driving shaft 22 at step S134 of the operation mode judging manipulation routine of drawing 7 serves as a bigger value than maximum energy Pemax, energy Pe outputted from an engine 50 is set to maximum energy Pemax for providing as much energy of the energy Pd which should be outputted to a driving shaft 22 as possible with the energy outputted from an engine 50.
[0123] Then, the maximum energy Pemax in which an engine 50 to an output is possible is subtracted from the energy Pd which should be outputted to a driving shaft 22, and the energy running short is computed as assistant power Pas with the energy Pe outputted from an engine 50 (step S282). Then, based on the remaining capacity BRM of a dc-battery 94, the maximum discharge energy Pbmax which is the maximum of the energy which can discharge from a dc-battery 94 is drawn (step S284), and it judges whether it is larger than the maximum discharge energy Pbmax which the computed assistant power Pas drew (step S286). Here, the maximum discharge energy Pbmax is set up based on the remaining capacity BRM of a dc-battery 94 because the power (energy) which can discharge a dc-battery 94 may change with remaining capacity BRM. In the example, the maximum discharge energy Pbmax shall be searched for by experiment etc. from each remaining capacity BRM of the used dc-battery 94, it shall be beforehand memorized as a map (not shown) to ROM, and the maximum discharge energy Pbmax corresponding to the remaining capacity BRM of a dc-battery 94 shall be derived. When the assistant power Pas is larger than the maximum discharge energy Pbmax, the maximum discharge energy Pbmax is set as the assistant power Pas (step S288), and it is made for the assistant power Pas not to become larger than the maximum discharge energy Pbmax.
[0124] Next, processing which reads the engine speed Nd of a driving shaft 22 is performed (step S290), and target engine-speed Ne* of an engine 50 is compared with the engine speed Nd of a driving shaft 22 (step S292). And the 1st clutch 45 and the 2nd clutch 46 are operated so that the 1st clutch 45 has off target engine-speed Ne* of an engine 50 when larger than the engine speed Nd of a driving shaft 22, and the 2nd clutch 46 may serve as ON (configuration of the mimetic diagram of drawing 2 ) (step S294 thru/or S298). This processing is the same as the processing (step S174 thru/or processing of S177 and step S184 thru/or processing of S187) which operates the 1st clutch 45 and the 2nd clutch 46 in a usual

operation torque control routine of already explained drawing 9 and drawing 10 .
[0125] When smaller than the engine speed Nd of a driving shaft 22, the 1st clutch 45 operates [ target engine-speed Ne* of an engine 50 / the 2nd clutch 46 ] the 1st clutch 45 and the 2nd clutch 46 by ON so that OFF (configuration of the mimetic diagram of drawing 3 ) may come (step S304 thru/or S308). It is the same as that of the processing (step S174 thru/or processing of S177 and step S184 thru/or processing of S187) which operates the 1st clutch 45 and the 2nd clutch 46 in a usual operation torque control routine of drawing 9 and drawing 10 .
[0126] After connecting a clutch, torque command value Tc* of a motor MG 1 is set up so that target torque Te* of an engine 50 may be realized (step S266), and torque command value Ta* of a motor MG 2 is set up so that torque command value Td* which should be outputted to a driving shaft 22 may be attained (step S268). These values are computed based on an upper type (1).
[0127] In this way, if torque command value Tc* of a motor MG 1 and torque command value Ta* of a motor MG 2 are set up while operating both the clutches 45 and 46 according to the engine speed Nd of target engine-speed Ne* of an engine 50, and a driving shaft 22, each control of a motor MG 1, a motor MG 2, and an engine 50 will be performed using these set-up set points (step S314 thru/or S318).
[0128] According to power assistant torque control processing in which it explained above, the energy more than maximum energy Pemax of an engine 50 can be outputted to a driving shaft 22. Consequently, the low engine of the rated capacity which makes maximum energy energy smaller than the energy Pd which should be outputted to a driving shaft 22 can also be adopted as the power output unit 20, and a miniaturization and energy saving of the whole equipment can be attained. By operating the 1st clutch 45 and the 2nd clutch 46 based on the engine speed Ne of an engine 50, and the engine speed Nd of a driving shaft 22, and considering as the configuration of the mimetic diagram of drawing 2 , or the configuration of the mimetic diagram of drawing 3 from the first, the energy loss by the motor MG 1 and the motor MG 2 can be made small, and energy efficiency can be made high as the whole equipment. Moreover, if the operation point of an engine 50 is the operation point which outputs the set-up energy Pd, since it is good as any operation points, it can operate an engine 50 on the more efficient operation point. Consequently, energy efficiency of the whole equipment can be made higher.
[0129] (5) Explain direct-output torque control processing, next direct-output torque control processing (step S118 of drawing 5 ) based on the direct-output torque control routine of drawing 19 . This routine is performed when the rotational frequency Nd of torque command value Td* in step S138 of drawing 7 and a driving shaft 22 is in the range in which an output is possible without the change in the torque by the motor MG 2 when an engine 50 is operated in the range (the field PA of drawing 8 ) which can be operated efficiently. If this routine is performed, the control CPU 90 of a control unit 80 will perform first processing which reads the rotational frequency Nd of a driving shaft 22 (step S320). Next, target torque Te* of an engine 50 and target rotational frequency Ne* are set up, respectively (step S322). As target rotational frequency Ne*, the rotational frequency Nd of a driving shaft 22 is set up. Moreover, as target torque Te*, torque command value Td* of a driving shaft 22 is set up.
[0130] Then, when [ both ] it investigates whether both the 1st clutch 45 and the 2nd clutch 46 serve as ON (step S324) and neither of both clutches 45 and 46 serve as ON, both the clutches 45 and 46 are set to ON (step S326). Thus, by operating the 1st clutch 45 and the 2nd clutch 46, the power output unit 20 serves as a configuration which coupled directly the crankshaft 56 and the driving shaft 22. Planetary gear 200 stop consequently, doing the distribution frame of power so.
[0131] Next, a value 0 is set as both torque command value Tc* of a motor MG 1, and torque command value Ta* of a motor MG 2 (steps S328 and S330), and each control of a motor MG 1, a motor MG 2, and an engine 50 is performed (step S332 thru/or S336). Here, as control of the motors MG1 and MG2 when a value 0 is set as torque command value Ta*, although the motor control routine of drawing 13 can perform, since what is necessary is just to make all the currents of each phase of motors MG1 and MG2 into a value 0, in the example, all the transistors of the drive circuits 91 and 92 are set to OFF.
[0132] According to direct-output torque control processing in which it explained above, it can output to the direct-drive shaft 22 by setting both the 1st clutch 45 and the 2nd clutch 46 to ON, without carrying out torque conversion of the power outputted from an engine 50. Therefore, the energy loss by the motor

MG 1 and the motor MG 2 can be made into zero. And since this direct-output torque control processing is performed when there is an engine speed Nd of the torque (torque command value Td*) which should be outputted to a driving shaft 22, and a driving shaft 22 within limits which can operate an engine 50 efficiently, it can output power to a driving shaft 22 more efficiently.
[0133] In addition, although considered as the same actuation as the configuration which sets a value 0 as torque command value Tc* of a motor MG 1, and torque command value Ta* of a motor MG 2, and a motor MG 1 and a motor MG 2 do not have in both the power output units 20 of an example It is good also as what outputs power to a driving shaft 22 from a motor MG 2, or revives power from a driving shaft 22 by the motor MG 2 using the electrical energy which discharges from a dc-battery 94, and charges a dc-battery 94. It can perform, if the engine speed Nd of a driving shaft 22 is in the range which can operate an engine 50 efficiently, without being restricted at the time that the torque (torque command value Td*) which should output direct-output torque control processing to a driving shaft 22, and the engine speed Nd of a driving shaft 22 are in the range (the field PA of drawing 8 ) which can operate an engine 50 efficiently if it carries out like this. Hereafter, such direct-output torque control processing is briefly explained based on the direct-output torque control routine of drawing 20 .
[0134] When the direct-output torque control routine of drawing 20 is performed, the control CPU 90 of a control unit 80 First, read the rotational frequency Nd of a driving shaft 22 (step S340), and the rotational frequency Nd of the read driving shaft 22 is set as target rotational frequency Ne* of an engine 50 (step S342). It investigates whether both the 1st clutch 45 and the 2nd clutch 46 are ON (step S344), and when [ both ] neither of both clutches 45 and 46 are ON, both the clutches 45 and 46 are set to ON (step S346). Next, processing which reads the pull up torque T1 and the maximum torque T2 in the range (the field PA of drawing 8 ) which can operate efficiently the engine 50 in the engine speed Nd of a driving shaft 22 is performed (step S348), and it compares with the pull up torque T1 and the maximum torque T2 which read torque command value Td* (step S350). In addition, in the example, reading of pull up torque T1 and the maximum torque T2 memorizes beforehand the engine 50 to each engine speed Nd of a driving shaft 22 to ROM in quest of the pull up torque T1 and the maximum torque T2 of the range which can be operated efficiently by experiment etc., and if the engine speed Nd of a driving shaft 22 is read, it shall derive pull up torque T1 and the maximum torque T2 from this engine speed Nd and map.
[0135] If torque command value Td* is less than [ maximum torque T2 ] more than in pull-up-torque T1 Torque command value Td* is set as target torque Te* of an engine 50 (step S354). When torque command value Td* is less than [ pull-up-torque T1 ], pull up torque T1 is set as target torque Te* (step S352), and torque command value Td* sets the maximum torque T2 as target torque Te*, when larger than the maximum torque T2 (step S356). Thus, by setting up, the operation point of target torque Te* of an engine 50 and target engine-speed Ne* becomes in the range (the field PA of drawing 8 ) which can operate efficiently the engine 50 mentioned above.
[0136] Then, while setting a value 0 as torque command value Tc* of a motor MG 1 (step S358), what subtracted target torque Te* of an engine 50 from torque command value Td* is set as torque command value Ta* of a motor MG 2 (step S360). In this way, a setup of target torque Te* of an engine 50, target rotational frequency Ne*, torque command value Tc* of a motor MG 1, and torque command value Ta* of a motor MG 2 performs each control (step S362 thru/or S366) of a motor MG 1, a motor MG 2, and an engine 50 using these set points.
[0137] Drawing 21 is an explanatory view which illustrates signs that power is outputted to the driving shaft 22 at the time of performing the direct-output torque control routine of such drawing 20 . When torque command value Td* which the driving shaft 22 is rotating at the rotational frequency Nd1, and becomes settled now according to the amount of treading in of an accelerator pedal 64 is a value Td1, the time of wanting to operate a driving shaft 22 on the operation point Pd 1 is considered. Although an engine speed Nd1 is in the range PA which can operate an engine 50 efficiently, torque command value Td* is in the condition far exceeding the upper limit of this range PA. At this time, the torque (value Te 1) of the upper limit of the range PA in a rotational frequency Nd1 is set as target torque Te* of an engine 50 as the maximum torque T2 (step S356). Since an engine speed Nd1 is set as target engine-

speed Ne* of an engine 50 as it is (step S342), an engine 50 will be operated on the operation point Pe1 with which it is expressed at torque Te 1 and an engine speed Nd1. Since torque command value Ta* of a motor MG 2 is called for as torque (value Ta 1) which subtracted target torque Te* (value Te 1) of an engine 50 from torque command value Td* (value Td1) (step S360) The energy given to a driving shaft 22 By setting both the 1st clutch 45 and the 2nd clutch 46 to ON It becomes the energy (Td1xNd1) which added the energy (Ta1xNd1) outputted to the direct-drive shaft 22 from a motor MG 2 at the energy (Te1xNd1) outputted to the direct-drive shaft 22 from an engine 50. In addition, the energy outputted to a driving shaft 22 from a motor MG 2 is provided by the power which discharges from a dc-battery 94.

[0138] Next, the time of the driving shaft 22 rotating at the rotational frequency Nd2, and wanting to operate a driving shaft 22 on the operation point Pd 2 in drawing 21 , when output-torque command value Td* is a value Td2 is considered. Although an engine speed Nd2 is in the range PA which can operate an engine 50 efficiently, torque command value Td* is in the condition which is less than the minimum of this range PA. At this time, the torque (value Te 2) of the lower limit of the range PA in a rotational frequency Nd2 is set as target torque Te* of an engine 50 as pull up torque T1 (step S352). Since an engine speed Nd2 is set as target engine-speed Ne* of an engine 50 as it is (step S342), an engine 50 will be operated on the operation point Pe2 expressed with torque Te 2 and an engine speed Nd2. Since torque command value Ta* of a motor MG 2 is called for as torque (the negative value Ta 2) which subtracted target torque Te* of an engine 50 from torque command value Td* (step S360) The energy given to a driving shaft 22 By setting both the 1st clutch 45 and the 2nd clutch 46 to ON It becomes the energy (Td2xNd2) which subtracted the energy (Ta2xNd2) equivalent to the power revived by the motor MG 2 from the energy (Te2xNd2) outputted to the direct-drive shaft 22 from an engine 50. In addition, the power revived by the motor MG 2 is used for charge of a dc-battery 94.

[0139] If the rotational frequency Nd of a driving shaft 22 is within the limits of this even if there is no torque (torque command value Td*) which should be outputted to a driving shaft 22 if the direct-output torque control routine of the modification shown in drawing 20 with the power output unit 20 of an example is performed as explained above into the range (the field PA of drawing 8 ) which can operate an engine 50 efficiently, direct-output torque control processing can be performed. And since a motor MG 2 is driven by the charge and discharge of a dc-battery 94 with the torque of the deflection of target torque Te* of an engine 50, and torque command value Td*, desired torque can be made to act on a driving shaft 22.

[0140] (6) Explain motor driving torque control processing, next motor driving torque control processing (step S120 of drawing 5 ) based on the motor driving torque control routine of drawing 22 . This routine is performed when the energy Pd which should be outputted to a driving shaft 22 at steps S142 and S144 of drawing 7 is judged that the rotational frequency Nd of a driving shaft 22 is smaller than the predetermined rotational frequency NML smaller than the predetermined energy PML.

[0141] When this routine is performed, the control CPU 90 of a control unit 80 First, it investigates whether the stop instruction of operation of an engine 50 is outputted (step S370). The signal which suspends operation of an engine 50 when the stop instruction of operation of an engine 50 is outputted is transmitted to EFIECU70 (step S372). When the stop instruction of operation of an engine 50 is not outputted, the signal which makes an engine 50 idle operational status is transmitted to EFIECU70 (step S374). The stop instruction of operation of an engine 50 here may be outputted to setting to ON the switch which directs a halt of the case where it is outputted from EFIECU70 according to the condition of the catalyst equipment which was formed in the operational status of an engine 50 or the exhaust pipe of an engine 50, and which is not illustrated etc., and the engine 50 which an operator does not illustrate. In addition, although control of an engine 50 was expressed with drawing 22 as step S390 on account of illustration Since it is carried out separately [ control of an engine 50 ] from such a torque control routine independently as mentioned above, When the signal with which the control CPU 90 of a control device 80 suspends operation of an engine 50 to EFIECU70, and the signal which makes an engine 50 idle operational status are transmitted, EFIECU70 Control of an engine 50 is started so that it may be in a halt or idle operational status about an engine 50 immediately. Control of an engine 50 turns into

control which stops impression of the electrical potential difference to an ignition plug 62 while suspending the fuel injection from a fuel injection valve 51, when the stop instruction of operation of an engine 50 is outputted. When making an engine 50 into idle operational status It becomes the control of the opening of an idle speed control valve and the control of fuel oil consumption which were prepared in the communicating tube for idle control which bypasses a throttle valve so that an engine 50 may be operated with idle rpm after making a throttle valve into a close by-pass bulb completely, and which is not illustrated and which are not illustrated.

[0142] Next, the 1st clutch 45 is off and it investigates whether the 2nd clutch 46 serves as ON (configuration of the mimetic diagram of drawing 2 ) (step S376), and when [ both ] it will be in the condition that both the clutches 45 and 46 tend to set up, the 2nd clutch 46 is once set to ON after that by setting both the clutches 45 and 46 to OFF (step S378) (step S380). And torque command value Td* which is the torque which should be outputted to a driving shaft 22 is set as torque command value Ta* of a motor MG 2 (step S382), the value which is equivalent to the reaction force torque at torque command value Tc* of a motor MG 1 is set up (step S384), and each control of a motor MG 1, a motor MG 2, and an engine 50 is performed (step S386 thru/or S390).

[0143] According to motor driving torque control processing in which it explained above, a car can be driven only under the power outputted from a motor MG 2 by setting the 1st clutch 45 to OFF, considering the power output unit 20 as the configuration of the mimetic diagram of drawing 2 by setting the 2nd clutch 46 to ON, and supporting the reaction force torque of a motor MG 2 by the motor MG 1 further. And such motor driving torque control processing is performed when the energy Pd which should be outputted to a driving shaft 22 serves as the low operation point of the effectiveness of an engine 50, and since operation of an engine 50 is suspended or an engine 50 is made into idle operational status, decline in the energy efficiency by operating an engine 50 on the low operation point of effectiveness is avoidable.

[0144] Although the 1st clutch 45 shall be set to OFF, the power output unit 20 shall be considered as the configuration of the mimetic diagram of drawing 2 by setting the 2nd clutch 46 to ON and power shall be outputted to a driving shaft 22 from a motor MG 2 in motor driving torque control processing of an example It is good also as what sets the 1st clutch 45 to ON, considers the power output unit 20 as the configuration of the mimetic diagram of drawing 3 by setting the 2nd clutch 46 to OFF, and outputs power to a driving shaft 22 by the motor MG 1 and the motor MG 2. Such motor driving torque control processing is made by the motor driving torque control routine of the modification illustrated to drawing 23 . Hereafter, motor driving torque control processing of this modification is explained briefly.

[0145] After transmitting the signal which suspends operation of an engine 50, or the signal which makes an engine 50 idle operational status to EFIECU70 by the routine of this modification, (Step S400 thru/or S404), The 1st clutch 45 investigates whether the 2nd clutch 46 serves as OFF (configuration of the mimetic diagram of drawing 3 ) by ON (step S406). When it will be in the condition that both the clutches 45 and 46 tend to set up, the 1st clutch 45 is set to ON after that, both [ once ] using both the clutches 45 and 46 as off (step S408) (step S410). And torque command value Tc* (step S412) of a motor MG 1 and torque command value Ta* of a motor MG 2 are set up. Both value is set up based on a top type (1) so that desired torque may be outputted from a driving shaft 22. In this way, according to the set-up torque command value, each control of a motor MG 1, a motor MG 2, and an engine 50 is performed (step S416 thru/or S419). Thus, the torque equivalent to torque command value Td* can be outputted to a driving shaft 22 from a motor MG 1 by setting up torque command value Tc* and Ta*. In addition, when an engine 50 is in the condition of shutdown, it is good also as what carries out the lock-up of the motor MG 2. Moreover, when making an engine 50 into idle operational status, it is good also as what carries out feedback control of torque command value Ta* of a motor MG 2 so that the engine speed Ne of a crankshaft 56 may turn into idle rpm.

[0146] Moreover, although the 1st clutch 45 shall be set to OFF, the power output unit 20 shall be considered as the configuration of the mimetic diagram of drawing 2 by setting the 2nd clutch 46 to ON and power shall be outputted to a driving shaft 22 from a motor MG 2 in motor driving torque control processing of an example, it is good also as what drives a driving shaft 22 by the motor MG 2 by setting

both the clutches 45 and 46 of both to ON. Such motor driving torque control processing is made by the motor driving torque control routine of the modification illustrated to drawing 24 . Hereafter, motor driving torque control processing of this modification is explained briefly.

[0147] If the routine of this modification is performed, the control CPU 90 of a control device 80 will transmit first the signal which suspends operation of an engine 50 to EFIECU70 (step S420). EFIECU70 which received the signal which suspends operation of this engine 50 stops the fuel injection to an engine 50, and ignition, and suspends operation of an engine 50. Then, when it investigates whether both the 1st clutch 45 and the 2nd clutch 46 serve as ON (step S421) and both the clutches 45 and 46 of both will be in the condition of ON, both the clutches 45 and 46 are both made off (step S422). And a value 0 is set as torque command value Tc* of a motor MG 1 (step S423). Next, the engine speed Ne of the crankshaft 56 of an engine 50 is read (step S424), and the friction torque Tef of an engine 50 is derived based on the read engine speed Ne (step S425). If it is torque required to rotate the engine 50 with which the friction torque Tef has suspended operation here at an engine speed Ne, and considers as a map beforehand in quest of the relation between the engine speed Ne of an engine 50, and the friction torque Tef by experiment etc., it memorizes to ROM in the example and an engine speed Ne is read, the friction torque Tef corresponding to the engine speed Ne read using this map shall be derived. And the drawn friction torque Tef, torque (torque command value) Td* which should be outputted to a driving shaft 22, and the applied value are set up as torque command value Ta* of a motor MG 2 (step S426), and control of a motor MG 1 and a motor MG 2 is performed so that a motor MG 1 and a motor MG 2 may operate with the set-up value (steps S427 and S428).

[0148] Thus, the torque (value Td*) according to the amount of accelerator pedal 64 treading in can be outputted to a driving shaft 22 by setting the friction torque Tef, torque command value Td*, and the applied value as motor driving torque control processing of a modification, then torque command value Ta* of a motor MG 2, carrying out motoring of the engine 50, where both the clutches 45 and 46 of both are set to ON. In addition, although derivation of the friction torque Tef of an engine 50 was performed in this modification based on the engine speed Ne of an engine 50, since both the clutches 45 and 46 of both were set to ON and the crankshaft 56 and the driving shaft 22 have joined together mechanically, of course, it is good also as what is derived based on the engine speed Nd of a driving shaft 22.

[0149] According to the operation control explained above, the power for which an operator asks can be outputted to a driving shaft 22. And since more efficient operation mode is chosen according to the remaining capacity BRM of the power (energy Pd) for which an operator asks, or a dc-battery 94, and the rotational frequency Nd of a driving shaft 22, energy efficiency of the whole equipment can be made higher. Furthermore, the energy loss of the motor MG 1 at the time of carrying out torque conversion of the power outputted from the engine 50 and a motor MG 2 can be made small by operating the 1st clutch 45 and the 2nd clutch 46 according to target engine-speed Ne* of an engine 50, and the engine speed Nd of a driving shaft 22 by each operation mode. Consequently, energy efficiency of the whole equipment can be made higher.

[0150] Although operation torque control processing, charge-and-discharge torque control processing, power assistant torque control processing, direct-output torque control processing, and motor driving torque control processing shall usually be chosen and performed in the operation control of an example according to the remaining capacity BRM of the power (energy Pd) for which an operator asks, or a dc-battery 94, and the rotational frequency Nd of a driving shaft 22, it does not interfere as what does not process the part of these processings.

[0151] Moreover, although direct-output torque control processing was performed in the operation control of an example when torque command value Td* which is the torque and the engine speed Nd of a driving shaft 22 which should be outputted to a driving shaft 22 were in the range (the field PA of drawing 8 ) which can operate an engine 50 efficiently When target engine-speed Ne* of an engine 50 and the engine speed Nd of a driving shaft 22 are within the limits of predetermined, or when the engine-speed difference Nc which is the deflection of the engine speed Ne of an engine 50 and the engine speed Nd of a driving shaft 22 is in predetermined within the limits, it is good also as what performs direct-output torque control processing. Usually, as for a motor, effectiveness becomes high

most at the time of the operational status near the rated value, and effectiveness also becomes low at the time of the operational status which is remarkably separated from the operational status. The engine speed of a motor MG 1 is the engine-speed difference Nc which is the deflection of the engine speed Ne of an engine 50, and the engine speed Nd of a driving shaft 22, since it becomes the deflection of the target engine-speed Ne* of an engine 50 and the engine speed Nd of a driving shaft 22 in a steady state, when this deflection is small, a motor MG 1 will be operated at a small engine speed, and that effectiveness also becomes low. Therefore, if direct-output torque control processing is performed as mentioned above when the engine speed of a motor MG 1 is small, decline in the energy efficiency of the whole equipment by decline in the effectiveness of a motor MG 1 can be prevented by connecting a crankshaft 56 and a driving shaft 22 mechanically by setting both the 1st clutch 45 and the 2nd clutch 46 to ON. In addition, since the deflection of target torque Te* of an engine 50 and the torque (torque command value Td*) which should be outputted to a driving shaft 22 also becomes small when the deflection of the engine speed Nd of target engine-speed Ne* of an engine 50 and a driving shaft 22 is small, when it is usually in the range (the field PA of drawing 8 ) which can operate an engine 50 efficiently, it corresponds.
[0152] In the operation control of an example, when the torque (torque command value Td*) which should be outputted to a driving shaft 22, and the engine speed Nd of a driving shaft 22 were in the range (the field PA of drawing 8 ) which can operate an engine 50 efficiently, or when the engine speed Nd of a driving shaft 22 was within the limits of this even if there was no torque command value Td* within limits which can operate an engine 50 efficiently, direct-output torque control processing ( drawing 19 or drawing 20 ) was performed. Not only this case but when a certain abnormalities arise on a motor MG 1, it is good also as what outputs power to a driving shaft 22 from an engine 50 and a motor MG 2 by setting both the 1st clutch 45 and the 2nd clutch 46 to ON. In this case, what is necessary is to output power to a driving shaft 22 by the motor MG 2, where motoring of the engine 50 is carried out, and just to drive a car, when starting a car, or when [ when the vehicle speed is small ] the engine speed Nd of a driving shaft 22 turns into an engine speed below the minimum engine speed which can operate an engine 50. And what is necessary is to put an engine 50 into operation, when the engine speed Nd of a driving shaft 22 becomes more than the minimum engine speed which can operate an engine 50, to output the power outputted from an engine 50, and the power outputted from a motor MG 2 to a driving shaft 22, and just to drive a car. If it carries out like this, even when abnormalities arise on a motor MG 1, power can be outputted to a driving shaft 22 and a car can be driven.
[0153] Although motor driving torque control processing shall be performed in the operation control of an example when the energy Pd which should be outputted to a driving shaft 22 is judged that the rotational frequency Nd of a driving shaft 22 is smaller than the predetermined rotational frequency NML smaller than the predetermined energy PML, it is good also as what performs motor driving torque control processing irrespective of the rotational frequency Nd of the energy Pd which should be outputted to such a driving shaft 22, and a driving shaft 22. For example, when an operator sets to ON the motor drive mode setting switch which is not illustrated, it is good also as what performs motor driving torque control processing.
[0154] D. Explain starting control processing of the engine 50 in starting control of an engine, next the power output unit 20 of an example. In the power output unit 20 of an example, when a car is in a idle state, in case transit of a car is started by the above-mentioned motor driving torque control processing where the engine 50 besides in the case of putting an engine 50 into operation is suspended and it switches to a torque control besides after that, when putting an engine 50 into operation, namely, when a car is in a run state, an engine 50 may be put into operation. First, starting processing of the engine 50 in case a car is in a idle state is explained based on the engine starting manipulation routine of drawing 25 , and starting processing of the engine 50 in case a car is in a run state after that is explained.
[0155] The engine starting manipulation routine of drawing 25 is performed when a starting switch 79 is turned on by the operator. If this routine is performed, the control CPU 90 of a control device 80 will consider the power output unit 20 as the configuration of the mimetic diagram of drawing 3 by setting the 2nd clutch 46 to OFF (step S432) first while setting the 1st clutch 45 to ON (step S430). Then, the

starter torque TST is set as torque command value Ta* of a motor MG 2 (step S434), and a motor MG 2 is controlled (step S436). At this time, torque command value Tc* of a motor MG 1 is set up (step S435), and a motor MG 1 is controlled so that power is not outputted to a driving shaft 22 through planetary gear 200 (step S436). Thus, motoring of the crankshaft 56 of an engine 50 is carried out by operating both the clutches 45 and 46 and controlling a motor MG 2. Here, the starter torque TST is set up as torque which the friction torque of an engine 50 can be overcome [ torque ] and can rotate an engine 50 at the rotational frequency more than the predetermined rotational frequency NST.
[0156] Next, the rotational frequency Ne of an engine 50 is read (step S437), and the read rotational frequency Ne is compared with the predetermined rotational frequency NST (step S438). Here, the predetermined engine speed NST is set up as an engine speed more than the minimum engine speed which is stabilized and can carry out continuous running of the engine 50. When the rotational frequency Ne of an engine 50 is smaller than the predetermined rotational frequency NST, it returns to step S436, step S436 thru/or processing of S440 are repeated, and it waits for the rotational frequency Ne of an engine 50 to turn into more than the predetermined rotational frequency NST. If the rotational frequency Ne of an engine 50 becomes more than the predetermined rotational frequency NST, the signal which starts the fuel-injection control and ignition control by EFIECU70 will be transmitted to EFIECU70 (step S439), and this routine will be ended. In addition, EFIECU70 which received the signal which starts fuel-injection control and ignition control controls opening of the idle speed control valve which was mentioned above and which is not illustrated while starting the fuel-injection control from a fuel injection valve 51, and the ignition control in an ignition plug 62 so that an engine 50 may be operated with idle rpm.
[0157] According to engine starting processing in which it explained above, an engine 50 can be put into operation in the condition that the car has stopped. And since it considers as the condition that Rota 41 of a motor MG 2 was connected to the crankshaft 56, having set the 1st clutch 45 to ON and having used the 2nd clutch 46 as off and an engine 50 is rotated by the motor MG 2, it is not necessary to form the motor for starting of an engine 50 independently. Consequently, the whole equipment can be used as a compact.
[0158] Although motoring of the engine 50 was carried out by the motor MG 2 in engine starting processing of an example, having set the 1st clutch 45 to ON and having used the 2nd clutch 46 as off, it is good also as what carries out motoring of the engine 50 by the motor MG 1 where it made the 1st clutch 45 off and the 2nd clutch 46 is set to ON. In this case, what is necessary is just to perform the engine starting manipulation routine illustrated to drawing 26 . Hereafter, this processing is explained briefly.
[0159] If the engine starting manipulation routine of drawing 26 is performed, first, the control CPU 90 of a control device 80 will set the 1st clutch 45 to OFF, and will consider the power output unit 20 as the configuration of the mimetic diagram of drawing 2 by setting the 2nd clutch 46 to ON (steps S440 and S441). And while setting the starter torque TST as torque command value Tc* of a motor MG 1 (step S442), the predetermined current IST (IuST, IvST, IwST) is set as the current Ia (Iua, Iva, Iwa) passed to each phase of the three phase coil 44 of a motor MG 2 (step S443), and control of a motor MG 1 and a motor MG 2 is performed (steps S445 and S446). Here, the predetermined current IST is set up as a current value which makes a motor MG 2 generate the torque which a driving shaft 22 does not rotate even if it makes the starter torque TST act on a crankshaft 56. Thus, by controlling a motor MG 1 and a motor MG 2, the rotation is restricted by the motor MG 2, a driving shaft 22 is fixed, and motoring of the crankshaft 56 of an engine 50 is carried out by the motor MG 1 which outputs the starter torque TST. And it waits for the rotational frequency Ne of an engine 50 to turn into more than the predetermined rotational frequency NST like the engine starting manipulation routine of drawing 25 (steps S447 and S448), and the signal which starts the fuel-injection control and ignition control by EFIECU70 is transmitted to EFIECU70 (step S449).
[0160] Thus, an engine 50 can be put into operation by the motor MG 1 and the motor MG 2 in the condition that the car has also suspended the configuration of the mimetic diagram of drawing 2 which set the 1st clutch 45 to OFF and set the 2nd clutch 46 to ON. Therefore, it is not necessary to form the

motor for [ ****** ] starting of an engine 50 independently in this case, and the whole equipment can be used as a compact.

[0161] Next, starting processing of the engine 50 in case a car is in a run state is explained. Starting processing of the engine 50 in case a car is in a run state is performed by the engine starting manipulation routine at the time of motorised [ which is illustrated to drawing 27 ]. This routine is performed when operation mode which is [ like / where an engine 50 is suspended, when motor driving torque control processing is made and the switch whose operator puts an engine 50 into operation, and which is not illustrated is set to ON, or when the remaining capacity BRM of a dc-battery 94 becomes smaller than a threshold BL ] different from motor drive mode by the operation mode judging manipulation routine of drawing 7 is set up. In addition, motor driving torque control processing sets to OFF the processing 45 by the motor driving torque control routine illustrated to drawing 22 , i.e., the 1st clutch, considers the power output unit 20 as the configuration of the mimetic diagram of drawing 2 by setting the 2nd clutch 46 to ON, and is performed by the processing which outputs torque command value Td* to a driving shaft 22 from a motor MG 2 in this condition.

[0162] If this routine is performed, the control CPU 90 of a control unit 80 will set first the value which added the starter torque TST at torque command value Td* as torque command value Ta* of a motor MG 2 while setting the starter torque TST as torque command value Tc* of a motor MG 1 (step S450) (step S452). And each control of a motor MG 1 and a motor MG 2 is performed (steps S454 and S456). This routine is performed when the power output unit 20 is considered as the configuration of the mimetic diagram of drawing 2 , as mentioned above. If the starter torque TST is outputted to a crankshaft 56 from a motor MG 1 with this configuration, motoring of the engine 50 will be carried out by this torque. At this time, the torque according to the starter torque TST is outputted to a driving shaft 22 by operation of planetary gear 200 as reaction force. For this reason, torque smaller than the torque (torque command value Td*) which an operator wants will be outputted to a driving shaft 22, and a torque shock will produce only the thing which sets torque command value Td* as torque command value Ta* of a motor MG 2 like step S384 of the motor driving torque control routine of drawing 22 , then a part of anti-torque to be outputted to a driving shaft 22 from a motor MG 1 with starting of an engine 50. In the example, as shown in step S452, such a torque shock is negated by setting the value which added the starter torque TST at torque command value Td* as torque command value Ta* of a motor MG 2.

[0163] Thus, if motoring by the motor MG 1 of an engine 50 is performed, it will wait for the rotational frequency Ne of an engine 50 to turn into more than the predetermined rotational frequency NST like processing of steps S437 and S438 of the engine starting manipulation routine of drawing 25 (steps S458 and S460), and the signal which starts the fuel-injection control and ignition control by EFIECU70 will be transmitted to EFIECU70 (step S462).

[0164] According to the engine starting manipulation routine, a car can put an engine 50 into operation to the midst it is running only with the power outputted from a motor MG 2 at the time of motorised [ which was explained above / of an example ]. Since starting of this engine 50 is made by the motor MG 1, it does not independently need to form a motor in starting of an engine 50. And since the torque outputted to a driving shaft 22 from a motor MG 2 is controlled to negate the torque outputted to a driving shaft 22 from a motor MG 1 in the case of motoring of an engine 50, the torque shock produced in case an engine 50 is put into operation can be made small, or it can lose.

[0165] At the time of motorised [ of an example ], an engine starting manipulation routine When the motor driving torque control routine of drawing 22 which outputs desired torque (torque command value Td*) to a driving shaft 22 from a motor MG 2 where it set the 1st clutch 45 to OFF and the power output unit 20 is considered as the configuration of the mimetic diagram of drawing 2 by setting the 2nd clutch 46 to ON is performed Although it is the processing which puts an engine 50 into operation Where it set the 1st clutch 45 to ON and the power output unit 20 is considered as the configuration of the mimetic diagram of drawing 3 by setting the 2nd clutch 46 to OFF, while fixing a crankshaft 56 by the motor MG 2 Also when the motor driving torque control routine of drawing 23 which outputs torque command value Td* to a driving shaft 22 from a motor MG 1 is performed, starting of an engine 50 is made by an

engine starting manipulation routine and the same control routine at the time of motorised [ which is illustrated to drawing 27 ].

[0166] According to this routine, an engine 50 can be put into operation to the midst it is running with the power outputted by acquiring reaction force from a motor MG 1 by the motor MG 2. Since starting of this engine 50 is made by the motor MG 2, it does not independently need to form a motor in starting of an engine 50. And since there is no fluctuation in the torque outputted to a driving shaft 22 from the motor MG 1 in the case of motoring of an engine 50, even in case an engine 50 is put into operation, there is no torque shock.

[0167] At the time of motorised [ of an example ], an engine starting manipulation routine When the motor driving torque control routine of drawing 22 which outputs desired torque (torque command value Td*) to a driving shaft 22 from a motor MG 2 where it set the 1st clutch 45 to OFF and the power output unit 20 is considered as the configuration of the mimetic diagram of drawing 2 by setting the 2nd clutch 46 to ON is performed Although it is the processing which puts an engine 50 into operation When the motor driving torque control routine of drawing 24 which outputs desired torque (torque command value Td*) to a driving shaft 22 is performed carrying out motoring of the engine 50 by the motor MG 2 where both the 1st clutch 45 and the 2nd clutch 46 are set to ON Starting of an engine 50 is made by the engine starting manipulation routine at the time of motorised [ which is illustrated to drawing 28 ].

[0168] When an engine starting manipulation routine is performed at the time of motorised [ which is illustrated to this drawing 28 ], the control CPU 90 of a control unit 80 First, step S424 of the motor driving torque control routine of drawing 24 thru/or the same processing as S427, Namely, the rotational frequency Ne of an engine 50 reads (step S490). The friction torque Tef of an engine 50 is drawn based on the read engine speed Ne (step S491). Torque command value Td* is added to the derived friction torque Tef, torque command value Ta* of a motor MG 2 is set up (step S492), and a motor MG 2 is controlled (step S493).

[0169] Next, the read rotational frequency Ne is judged that there is nothing to the rotational frequency which is stabilized and can operate an engine 50 when a rotational frequency Ne is smaller than the predetermined rotational frequency NST as compared with the predetermined rotational frequency NST (step S438), and step S490 thru/or processing of S494 are repeated until it returns to step S490 and a rotational frequency Ne turns into more than the predetermined rotational frequency NST. Thus, step S424 of the motor driving torque control routine of drawing 24 thru/or the same processing as S427 are repeated because it performs while this starting manipulation routine is driving by the motor MG 2. That is, it is because the crankshaft 56 and the driving shaft 22 are combined with the 1st clutch 45 and the 2nd clutch 46, so priority cannot be given to the rotational frequency Ne of an engine 50 over the rotational frequency Nd of a driving shaft 22 and it cannot be controlled.

[0170] When the engine speed Ne of an engine 50 is more than the predetermined engine speed NST, the fuel oil consumption when it being no-load and operating an engine 50 at an engine speed Ne is computed (step S495), and a signal is transmitted towards EFIECU70 so that the fuel-injection control and ignition control which inject the computed fuel oil consumption from a fuel injection valve 51 may be carried out (step S496). Here, it was no-load, and in the example, beforehand in quest of the engine speed Ne and the fuel oil consumption at the time of the engine 50 of unloaded condition, it memorized to ROM as a map by experiment etc., and the fuel oil consumption at the time of an engine speed Ne was calculated by deriving the fuel oil consumption corresponding to an engine speed Ne from this map, when the engine speed Ne was given. And torque command value Td* is set as torque command value Ta* of a motor MG 2 (step S497), a motor MG 2 is controlled (step S498), and this routine is ended. Thus, as for an engine 50, it is no-load to remove the friction torque Tef of an engine 50 from count of a setup of torque command value Ta* of a motor MG 2, and it is because it is operated at a rotational frequency Ne.

[0171] According to the engine starting manipulation routine, an engine 50 can be put into operation to the midst which is outputting power to the driving shaft 22 at the time of motorised [ which was explained above / of a modification ], rotating an engine 50 by the motor MG 2. And it is no-load in an engine 50, and since torque command value Td* is set as torque command value Ta* of a motor MG 2

while adjusting fuel oil consumption so that it may be operated at a rotational frequency Ne, the torque shock at the time of putting an engine 50 into operation can be made small. In addition, at the time of motorised [ of a modification ], in an engine starting manipulation routine, although it shall be no-load and an engine 50 shall be operated at a rotational frequency Ne, it is good also as what is operated at a rotational frequency Ne with the load torque Te. In this case, what is necessary is just to set what subtracted the load torque Te from torque command value Td* as torque command value Ta* of a motor MG 2, in order to make small the torque shock in the case of starting of an engine 50. At the time of motorised [ of a modification ], moreover, in an engine starting manipulation routine Although step S490 thru/or processing of S494 shall be repeated at step S494 when the rotational frequency Ne of an engine 50 is smaller than the predetermined rotational frequency NST since priority cannot be given to the rotational frequency Ne of an engine 50 over the rotational frequency Nd of a driving shaft 22 and it cannot be controlled When the power output unit 20 is carried in what can change the rotational frequency Nd of a driving shaft 22 into comparison **** freedom, for example, a vessel, and the aircraft, it is good also as what gives priority to the rotational frequency Ne of an engine 50 over the rotational frequency Nd of a driving shaft 22, and controls it.
[0172] E. Explain the control at the time of reversing a car with go-astern control, next the power output unit 20 of an example. Go-astern control of a car is made by the torque control routine at the time of the go-astern illustrated to drawing 29 . This routine is repeatedly performed for every (every [ for example, ] 8msec) predetermined time, when the shift position sensor 84 detects that the shift lever 82 was set to the location of reverse by the operator.
[0173] If this routine is performed, when [ both ] it investigates whether the control CPU 90 of a control device 80 has the 1st off clutch 45, and the 2nd clutch 46 is in the condition (condition of the configuration of the mimetic diagram of drawing 2 ) of ON first (step S500) and will be in this condition, once setting both the clutches 45 and 46 to OFF, (step S502) and the 2nd clutch 46 are set to ON (step S504). When changing into the condition that both the clutches 45 and 46 should set up, the reason for both [ once ] making both the clutches 45 and 46 off was explained. Next, while reading the engine speed Nd of a driving shaft 22 (step S506), the torque (torque command value Td*) which should read the accelerator pedal position AP detected by accelerator pedal position sensor 64a (step S508), and should output it to a driving shaft 22 based on the engine speed Nd of the read driving shaft 22 and the accelerator pedal position AP is derived. Although the technique of derivation of such torque command value Td* is the same as the technique explained by processing of step S104 of the operation control routine of drawing 5 , since the shift lever 82 is set as reverse, a negative value is drawn as torque command value Td* here.
[0174] If torque command value Td* is derived, the remaining capacity BRM of a dc-battery 94 is read (step S512), and the remaining capacity BRM of the read dc-battery 94 is measured with a threshold BL (step S514). When it judges that the remaining capacity BRM of a dc-battery 94 is in sufficient condition to drive a motor MG 2 when the remaining capacity BRM of a dc-battery 94 is beyond the threshold BL, it investigates whether the engine 50 is operated (step S516) and the engine 50 is operated, the signal which makes an engine 50 idle operational status is transmitted to EFIECU70 (step S518).
[0175] On the other hand, when the remaining capacity BRM of a dc-battery 94 is under the threshold BL at step S514, first, the energy Pd which should multiply the torque (torque command value Td*) which should be outputted to a driving shaft 22 by the rotational frequency Nd of a driving shaft 22, and should be outputted to a driving shaft 22 is computed (step S523), and target torque Te* of an engine 50 and target rotational frequency Ne* are set up based on the computed energy Pd (step S524). Here, the technique of setting up target torque Te* of an engine 50 and target rotational frequency Ne* is the same as the technique explained at step S170 in drawing 9 and the usual operation torque control of drawing 10 . In addition, as mentioned above, torque command value Td* is a negative value, but since it is a time of reversing a car and the rotational frequency Nd of a driving shaft 22 also serves as a negative value, Energy Pd serves as a forward value like the time of advancing a car.
[0176] The torque set as torque command value Tc* of a motor MG 1 by the top type (1) based on target

torque Te* of an engine 50 is set up. Next, to torque command value Ta* of a motor MG 2 The torque of the difference of the torque and torque command value Td* which are outputted to a driving shaft 22 according to target torque Te* of an engine 50 is set up (step S530), and each control of a motor MG 1, a motor MG 2, and an engine 50 is performed (step S532). Although the engine 50 is rotating in the forward direction when the remaining capacity BRM of a dc-battery 94 is judged to be under the threshold BL at step S514, it comes to reverse a driving shaft 22 by rotating a motor MG 1 at a rotational frequency higher than the rotational frequency of an engine 50.
[0177] According to go-astern control of the car explained above, a car can be reversed. When the remaining capacity BRM of a dc-battery 94 is enough, a car can be reversed by outputting power from a motor MG 2 using the power which discharges from a dc-battery 94. Moreover, a car can be reversed when the hand of cut of an engine 50 carries out torque conversion of the power outputted from an engine 50 by the motor MG 1 and the motor MG 2 at the power of the reverse sense. Since the go-astern by this torque conversion can be performed irrespective of the remaining capacity BRM of a dc-battery 94, a car can be reversed, even when the remaining capacity BRM of a dc-battery 94 is inadequate and the discharge from a dc-battery 94 cannot make.
[0178] Although torque conversion of all the energy Pe outputted from an engine 50 shall be carried out by the motor MG 1 and the motor MG 2 and it shall output to a driving shaft 22 in go-astern control of the car of an example when the remaining capacity BRM of a dc-battery 94 is under the threshold BL It is good also as what provides a part of energy Pd which shall charge a dc-battery 94 by a part of energy Pe outputted from an engine 50, or should be outputted to a driving shaft 22 by discharge from a dc-battery 94. In this case, what is necessary is just to set up target torque Te* of an engine 50, and target rotational frequency Ne* according to the energy Pe of a value smaller than Energy Pe and Energy Pd of a bigger value than the energy Pd which should be outputted to a driving shaft 22.
[0179] Although the 1st clutch 45 was set to OFF and the power output unit 20 reversed the car as a configuration of the mimetic diagram of drawing 2 by setting the 2nd clutch 46 to ON in go-astern control of the car of an example, it is good also as what the 1st clutch 45 is set [ what ] to ON and the power output unit 20 reverses a car as a configuration of the mimetic diagram of drawing 3 by setting the 2nd clutch 46 to OFF as for. In this case, what is necessary is just to perform a torque control routine at the time of the go-astern illustrated to drawing 30 . The point of operating both the clutches 45 and 46 so that a torque control routine may set the 1st clutch 45 to ON and it may become the configuration of the mimetic diagram of drawing 3 about the power output unit 20 by setting the 2nd clutch 46 to OFF at the time of go-astern of this drawing 30 (step S540 thru/or S544), Except for the point that the values set as torque command value Tc* of a motor MG 1 and torque command value Ta* of a motor MG 2 based on the on-off conditions of both such clutches 45 and 46 differing differ, it is the same as that of a torque control routine at the time of go-astern of drawing 29 .
[0180] It sets to a torque control routine at the time of go-astern of drawing 30 . The control CPU 90 of a control unit 80 When the remaining capacity BRM of a dc-battery 94 is beyond the threshold BL at step S554 The torque which can output torque command value Td* to a driving shaft 22 as torque command value Tc* of a motor MG 1 based on an upper type (1) is set up, and the torque equivalent to the anti-torque of a motor MG 1 is set up as torque command value Ta* of a motor MG 2 (step S570). In addition, when an engine 50 is in the condition of shutdown, it is good also as what carries out the lock-up of the motor MG 2. Moreover, when making an engine 50 into idle operational status, it is good also as what carries out feedback control of torque command value Ta* of a motor MG 2 so that the engine speed Ne of a crankshaft 56 may turn into idle rpm.
[0181] On the other hand, although torque command value Tc* of a motor MG 1 is the same as that of **** when the remaining capacity BRM of a dc-battery 94 is under the threshold BL at step S554, the value which subtracted target torque Te* of an engine 50 from the torque command value equivalent to anti-torque is set as torque command value Ta* of a motor MG 2 (step S570).
[0182] A car can be reversed also by go-astern control of the modification explained above. When the remaining capacity BRM of a dc-battery 94 is enough, while outputting power from a motor MG 1 using the power which discharges from a dc-battery 94, a car can be reversed by responding to the reaction

force by the motor MG 2. Moreover, a car can be reversed when the hand of cut of an engine 50 carries out torque conversion of the power outputted from an engine 50 by the motor MG 1 and the motor MG 2 at the power of the reverse sense. Since the go-astern by this torque conversion can be performed irrespective of the remaining capacity BRM of a dc-battery 94, a car can be reversed, even when the remaining capacity BRM of a dc-battery 94 is inadequate and the discharge from a dc-battery 94 cannot make.

[0183] Although torque conversion of all the energy Pe outputted from an engine 50 shall be carried out by the motor MG 1 and the motor MG 2 and it shall output to a driving shaft 22 in go-astern control of a modification when the remaining capacity BRM of a dc-battery 94 is under the threshold BL It is good also as what provides a part of energy Pd which shall charge a dc-battery 94 by a part of energy Pe outputted from an engine 50, or should be outputted to a driving shaft 22 by discharge from a dc-battery 94. In this case, what is necessary is just to set up target torque Te* of an engine 50, and target rotational frequency Ne* according to the energy Pe of a value smaller than Energy Pe and Energy Pd of a bigger value than the energy Pd which should be outputted to a driving shaft 22.

[0184] F. Explain both other operation controls, and next both clutches 45 and 46 based on drawing 31 about the actuation at the time of setting to OFF. If the torque control routine of drawing 31 is performed, the control CPU 90 of a control device 80 will set first torque command value Td* which is the torque which should be outputted to a driving shaft 22 as target torque Te* of an engine 50 (step S600). Then, it investigates whether both the 1st clutch 45 and the 2nd clutch 46 are off (step S602), and when neither of both clutches 45 and 46 are off, both the clutches 45 and 46 are both made off (step S604). Next, the rotational frequency Nd of a driving shaft 22 is read (step S606). And processing which reads the minimum rotational frequency N1 and maximum engine speed N2 in the range (the field PA of drawing 8 ) which can operate efficiently the engine 50 in torque command value Td* which is the torque which should be outputted to a driving shaft 22 is performed (step S608), and it compares with the minimum rotational frequency N1 and maximum engine speed N2 which read the rotational frequency Nd of a driving shaft 22 (step S610). In addition, in the example, reading of the minimum engine speed N1 and maximum engine speed N2 memorizes beforehand the engine 50 to each torque command value Td* to ROM in quest of the minimum engine speed N1 and maximum engine speed N2 of the range which can be operated efficiently by experiment etc., and if torque command value Td* is drawn, it shall derive the minimum engine speed N1 and maximum engine speed N2 from this torque command value Td* and map.

[0185] If the rotational frequency Nd of a driving shaft 22 is two or less maximum engine speed N at the one or more minimum rotational frequencies N The rotational frequency it is decided by the top formula (1) based on the rotational frequency Nd of a driving shaft 22 that will be target rotational frequency Ne* of an engine 50 is set up (step S614). When the rotational frequency Nd of a driving shaft 22 is the less than one minimum rotational frequency N, the minimum rotational frequency N1 is set as target rotational frequency Ne* (step S612), and when the rotational frequency Nd of a driving shaft 22 is larger than maximum engine speed N2, maximum engine speed N2 is set as target rotational frequency Ne* (step S616). Thus, by setting up, the operation point of target torque Te* of an engine 50 and target engine-speed Ne* becomes in the range (the field PA of drawing 8 ) which can operate efficiently the engine 50 mentioned above.

[0186] Then, while setting up the torque which becomes settled by the top type (1) as torque command value Tc* of a motor MG 1 based on target torque Te* of an engine 50 (step S618), a value 0 is set as torque command value Ta* of a motor MG 2 (step S620), and each control (step S622 thru/or S626) of a motor MG 1, a motor MG 2, and an engine 50 is performed.

[0187] Drawing 32 is an explanatory view which illustrates signs that power is outputted to the driving shaft 22 at the time of performing the torque control routine of such drawing 31 . When torque command value Td* which the driving shaft 22 is rotating at the rotational frequency Nd1, and becomes settled now according to the amount of treading in of an accelerator pedal 64 is a value Td1, the time of wanting to operate a driving shaft 22 on the operation point Pd 1 is considered. In addition, the following explanation explains as that to which gear ratio rho of planetary gear 200 is set so that the

torque outputted to a driving shaft 22 and the output torque of an engine 50 may become the same value. In drawing 32 , although the torque Td1 (torque command value Td*) which should be outputted to a driving shaft 22 is in the range PA which can operate an engine 50 efficiently, the rotational frequency Nd1 of a driving shaft 22 is in the condition which is much less than the minimum of this range PA. At this time, torque command value Td* (value Td1) is set as target torque Te* of an engine 50 (step S600). Since the rotational frequency (value Ne1) of the lower limit of the range PA in torque Td1 is set as target rotational frequency Ne* of an engine 50 as the minimum rotational frequency N1 (step S612) An engine 50 will be operated on the operation point Pe1 with which it is expressed at torque Td1 and a rotational frequency Ne1. Since a motor MG 1 will be operated according to the rotational frequency difference Nc1 (forward value) of the rotational frequency Ne1 of an engine 50, and the rotational frequency Nd1 of a driving shaft 22 at this time, the power (Td1xNc1) according to this rotational frequency difference Nc1 will be revived. This regeneration power is used for charge of a dc-battery 94.
[0188] Next, the time of the driving shaft 22 rotating at the rotational frequency Nd2, and wanting to operate a driving shaft 22 on the operation point Pd 2 in drawing 32 , when output-torque command value Td* is a value Td2 is considered. Although the torque Td2 (torque command value Td*) which should be outputted to a driving shaft 22 is in the range PA which can operate an engine 50 efficiently, the rotational frequency Nd2 of a driving shaft 22 is in the condition exceeding the upper limit of this range PA. At this time, torque command value Td* (value Td2) is set as target torque Te* of an engine 50 (step S600). Since the rotational frequency (value Ne2) of the upper limit of the range PA in torque Td2 is set as target rotational frequency Ne* of an engine 50 as maximum engine speed N2 (step S616) An engine 50 will be operated on the operation point Pe2 expressed with torque Te 2 and a rotational frequency Nd2. Since a motor MG 1 will be operated according to the rotational frequency difference Nc2 (negative value) of the rotational frequency Ne2 of an engine 50, and the rotational frequency Nd2 of a driving shaft 22 at this time, the power (Td2xNc2) according to this rotational frequency difference Nc2 will be consumed. The power consumed by this motor MG 1 is provided by discharge from a dc-battery 94.
[0189] When both the torque (torque command value Td*) which should be outputted to a driving shaft 22, and the engine speed Nd of a driving shaft 22 are in the range (the field PA of drawing 32 ) which can operate an engine 50 efficiently, torque command value Td* is set as target torque Te* of an engine 50 (step S600), and the engine speed Nd of a driving shaft 22 is set as target engine-speed Ne* of an engine 50 (step S614). Therefore, the rotational frequency Ne of an engine 50 and the rotational frequency Nd of a driving shaft 22 serve as the same value.
[0190] If the torque (torque command value Td*) which according to the torque control routine explained above should be outputted to a driving shaft 22 even if there is no engine speed Nd of a driving shaft 22 into the range (the field PA of drawing 8 ) which can operate an engine 50 efficiently is within the limits of this, the torque equivalent to torque command value Td* can output to a driving shaft 22 by setting both the clutches 45 and 46 to OFF, operating an engine 50 within limits which can be operated efficiently.
[0191] Such a torque control routine is not limited to the control when being within limits to which above-mentioned torque command value Td* can operate an engine 50 efficiently. For example, when a certain abnormalities arise on a motor MG 2, it is good also as what changes a rotational frequency into a driving shaft 22 by the motor MG 1, and outputs the power which both makes off the 1st clutch 45 and the 2nd clutch 46, and is outputted from an engine 50.
[0192] G. Although the 1st clutch 45 and the 2nd clutch 46 have been arranged between a motor MG 2 and a motor MG 1 in the power output unit 20 of an example explained beyond the modification As are shown in power output unit 20A of the modification of drawing 33 , and 1st clutch 45A and 2nd clutch 46B are arranged between an engine 50 and a motor MG 2 or are shown in power output unit 20B of the modification of drawing 34 1st clutch 45B is arranged between an engine 50 and a motor MG 2, and 2nd clutch 46B is good also as what is arranged between a motor MG 2 and a motor MG 1. Moreover, although the motor MG 2 has been arranged between an engine 50 and a motor MG 1 in the power output unit 20 of an example, as shown in power output unit 20C of the modification of drawing 35 , it

is good also as what arranges a motor MG 1 between an engine 50 and a motor MG 2.
[0193] Moreover, various association with an engine, motors MG1 and MG2, and planetary gear is also possible. For example, in the power output unit 20 of an example, the motor MG 1 was combined with the sun gear 221, and the engine 50 was combined with the planetary carrier 223. On the other hand, as shown in the power output unit of drawing 36 , a motor MG 1 can be combined with a planetary carrier, and an engine can also be combined with a sun gear. Of course, what changed various integrated states with other gears can be considered.
[0194] Although the motor MG 1 and the motor MG 2 have been arranged on the same axle in the power output unit 20 of an example, as shown in power output unit 20E of the modification of drawing 37 , it is good also as what stations both on a different shaft. a shaft top which arranges an engine 50, and a motor MG 1 and planetary-gear 200E on the same axle, and is different in a motor MG 2 in power output unit 20E of a modification -- arranging -- **** -- the ring wheel of planetary-gear 200E -- **** -- the good crankshaft is combined with one shaft of Clutches 45E and 46E with the belt, respectively.
[0195] Moreover, as shown in power output unit 20F of drawing 38 , a motor MG 2 may be arranged for an engine 50 on the same axle, and a motor MG 1 and planetary-gear 200F may be arranged on a different shaft. In this configuration, as for the engine crankshaft, one revolving shaft of clutch 46F is combined with the ring wheel shaft of planetary-gear 200F by the planetary carrier by the belt, respectively. Moreover, the ring wheel is combined with the driving shaft 22 by the belt.
[0196] The die length of the thing which arranges a motor MG 1 and a motor MG 2 on a different shaft like these modifications, then the shaft orientations of equipment can be shortened sharply. Consequently, it can consider as a thing advantageous to carrying equipment in a front-wheel driven car. Some which arrange such a motor MG 1 and Motor MG 2 on a different shaft have the degree of freedom of arrangement, such as the 1st clutch 45 and the 2nd clutch 46.
[0197] Although it was made to become a shaft top which is different in the crankshaft 56 and driving shaft 22 of an engine 50 in power output unit 20E which arranges a motor MG 1 and a motor MG 2 on a different shaft, or power output unit 20F, it is good also as what is made into a same axle top. Moreover, although between different shafts was combined with the belt in power output unit 20E of a modification, as shown in power output unit 20G of the modification of drawing 39 , it is good also as what is combined by gear association by the gear 102 and gear 104 which were attached in the crankshaft 56 and the driving shaft 22, and the gear 106 and gear 108 which were combined with one revolving shaft of planetary-gear 200G and clutch 46G.
[0198] Although the clutch performed connection with a motor MG 2, a crankshaft 56, or a driving shaft 22, and its discharge in the power output unit 20 of an example, as shown in power output unit 20H of the modification of drawing 40 , it is good also as what is performed by switch of gear association. The configuration of power output unit 20H of a modification is explained briefly. The gear 102 attached in the crankshaft 56 Rota revolving-shaft 38H [ of a modification ] of power output unit 20H, the gear 106 in which gear association is possible, and the gear 104 attached in the driving shaft 22 and the gear 108 in which gear association is possible are attached in the arrangement to which both gear association is carried out alternatively so that it may illustrate. Moreover, the actuator 100 made to move Rota revolving-shaft 38H to shaft orientations is formed in the edge in which the gear 108 of Rota revolving-shaft 38H was attached. Therefore, by driving this actuator 100, by making Rota revolving-shaft 38H slide to shaft orientations, as shown in drawing 40 (a) and drawing 40 (b), gear association with a gear 102 and a gear 106 and gear association with a gear 104 and a gear 108 can carry out alternatively.
[0199] Although connection between the Rota revolving shaft 38 and a crankshaft 56 and connection between the Rota revolving shaft 38 and a driving shaft 22 were made with the 1st clutch 45 and the 2nd clutch 46 in the power output unit 20 of an example, it is good also as what makes such connection combining a change gear and a clutch. for example, it is shown in power output unit 20J of the modification of drawing 41 -- as -- a crankshaft 56 and the Rota revolving shaft -- a change gear 120 and the 1st -- clutch 45J -- connecting -- a driving shaft 22 and the Rota revolving shaft -- a change gear 130 and the 2nd -- it is good also as what is connected by clutch 46J. The change gear 120 consists of a belt 125 held at the belt attachment components 122 and 124 of the pair attached in the crankshaft 56, and

two pairs of belt attachment components 122,124, and an actuator 126 for changing the path of the belt attachment component 124. Therefore, in a change gear 120, by changing the circumference radius of the belt 125 of the belt attachment component 124 with an actuator 126, it can change gears and the rotational frequency of a crankshaft 56 can be transmitted to the Rota revolving shaft. The change gear 130 attached in the 2nd clutch 46J side is also carrying out the same configuration.

[0200] According to power output unit 20J of a modification equipped with such a change gear 120 and a change gear 130, a change gear 120 and a change gear 130 can adjust the rotational frequency of the Rota revolving shaft. Consequently, a motor MG 2 can be operated on the more efficient operation point. Moreover, Clutches 45J and 46J are smoothly connectable by adjusting a change gear ratio with a change gear 120. consequently, the 1st -- the torque shock which may be produced at the time of connection by clutch 45J can be made small.

[0201] Although the change gear 120,130 was prepared for the both sides of connection, it is good power output unit 20J of a modification also as a thing of connection between a crankshaft 56 and Rota revolving-shaft 38J, a driving shaft 22, and Rota revolving-shaft 38J to prepare only in either. Moreover, although a rotational frequency shall be changed gears by the technique of changing the circumference radius of a belt 125 in power output unit 20J of a modification, since what kind of thing may be used as long as it can change gears and can transmit the rotational frequency of Rota revolving-shaft 38J to a crankshaft 56 or a driving shaft 22, it is good also as what changes gears by gear association of planetary gear etc.

[0202] As mentioned above, although the gestalt of operation of this invention was explained, as for this invention, it is needless to say that it can carry out with the gestalt which becomes various within limits which are not limited to the gestalt of such operation at all, and do not deviate from the summary of this invention.

[0203] For example, although the gasoline engine operated with a gasoline as an engine 50 was used in the power output unit 20 of the example mentioned above, various kinds of internal combustion, such as a diesel power plant, a turbine engine, and a jet engine, or an external combustion engine can also be used.

[0204] Moreover, in the power output unit 20 of an example, although PM form (permanent magnet form-ermanent Magnet type) synchronous motor was used as a motor MG 1 and a motor MG 2, if regeneration actuation and a powering movement are made to perform, VR form (adjustable reluctance form; Variable Reluctance type) synchronous motor, a vernier motor, a direct current motor, an induction motor, a superconducting motor, a step motor, etc. can also be used.

[0205] Or in the power output unit 20 of an example, although the transistor inverter was used as 1st and 2nd drive circuits 91 and 92, an IGBT (insulated-gate bipolar mode transistor; Insulated Gate Bipolar mode Transistor) inverter, a thyristor inverter, an electrical-potential-difference PWM (pulse-width-modulation-ulse Width Modulation) inverter, a square wave inverter (an electrical-potential-difference form inverter, current form inverter), a resonance inverter, etc. can also be used.

[0206] Moreover, as a dc-battery 94, although Pb dc-battery, a NiMH dc-battery, Li dc-battery, etc. can be used, it can replace with a dc-battery 94 and a capacitor can also be used.

[0207] Although the power output unit 20 of an example furthermore explained the case where a power output unit was carried in a car, this invention is not limited to this and, in addition to this, can also be carried [ means of transportation, such as a vessel and an aircraft, and ] in various industrial machines etc.

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TECHNICAL FIELD

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[Field of the Invention] This invention relates to the power output unit which outputs efficiently the power outputted from a prime mover to a driving shaft, and its control approach in detail about a power output unit and its control approach.

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[Translation done.]

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PRIOR ART

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[Description of the Prior Art] Conventionally, as this kind of a power output unit, it is equipment carried in a car, and what combines the driving shaft combined with the output shaft of a prime mover and Rota of a motor electromagnetic with a magnetic coupling, and outputs the power of a prime mover to a driving shaft is proposed (for example, JP,53-133814,A etc.). In this power output unit, if transit of a car is started with a motor and the rotational frequency of a motor turns into a predetermined rotational frequency, while giving an exciting current to a magnetic coupling and carrying out cranking of the prime mover, the fuel supply and jump spark ignition to a prime mover will be performed, and a prime mover will be put into operation. After a prime mover starts, the power from a prime mover is outputted to a driving shaft by electromagnetic association of a magnetic coupling, and it is made to run a car. A motor is driven when power required for a driving shaft is insufficient, and it compensates this insufficiency with the power outputted to a driving shaft by the magnetic coupling. When the magnetic coupling is outputting power to the driving shaft, it revives the power according to slipping of the electromagnetic association. This revived power is stored in a dc-battery as power used in the case of initiation of transit, or is used as power of the motor with which the insufficiency of the power of a driving shaft is compensated.

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EFFECT OF THE INVENTION

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[The means for solving a technical problem, and its operation and effectiveness] The power output unit of this invention provided the following means, in order to attain a part of above-mentioned purpose [ at least ].
[0008] The prime mover which the power output unit of this invention is a power output unit which outputs power to a driving shaft, and has an output shaft, The 1st shaft combined with said output shaft, and the 2nd shaft combined with said driving shaft, The power means of communication with which the power outputted and inputted by one residual shaft will be determined if the power which has the 3rd different shaft from this 1st shaft and the 2nd shaft, and is outputted and inputted by two shafts among these is determined, The 1st motor combined with said 3rd shaft, and the 2nd motor which has a different revolving shaft from said output shaft and said driving shaft, and exchanges power through this revolving shaft, Let it be a summary to have the 2nd connecting means which performs mechanical connection between the 1st connecting means which performs mechanical connection with said revolving shaft and said output shaft, and discharge of this connection, and said revolving shaft and said driving shaft, and discharge of this connection.
[0009] The power output unit of this invention can be connected to the output shaft of a prime mover, or can cancel the revolving shaft of the 2nd motor, and it can connect with a driving shaft or it can cancel it. Consequently, it can become possible to avoid that circulation of the power mentioned above arises, and the effectiveness of the whole equipment can be raised. The power output unit of this invention can take the operation mode which supplies the power revived with the 1st motor to the 2nd motor, and the operation mode which supplies the power regenerated with the 2nd motor to the 1st motor, when the 2nd motor is combined with the output shaft of a prime mover. Moreover, when the 2nd motor is combined with ******, two operation modes can be taken similarly. Thus, the power output unit of this invention can take a total of four operation modes. Therefore, it becomes possible to avoid circulation of power and to raise the effectiveness of the whole equipment by choosing the operation mode which circulation of power does not produce out of such operation modes.
[0010] In the power output unit of such this invention, it shall come for said the 1st connecting means and said 2nd connecting means to be constituted [ both ] by the clutch. If it carries out like this, each connecting means is realizable with a simple configuration.
[0011] Moreover, in the power output unit of this invention, a thing can also be carried out and it can also consider as the thing which comes to arrange said driving shaft and said output shaft on the same axle and which comes to arrange the revolving shaft of said 2nd motor on said driving shaft and said output shaft, and same axle further in this case. If it carries out like this, it can consider as arrangement advantageous to installing a power output unit in the tooth space formed on the straight line.
[0012] Moreover, a driving shaft, an output shaft, and the revolving shaft of the 2nd motor are set to the power output unit which it comes to arrange on the same axle. It shall come to arrange from said prime mover in order of said 2nd motor and said 1st motor, and shall come to arrange said the 1st connecting means and said 2nd connecting means between said 2nd motor and said 1st motor further in this case.
[0013] In the condition of having connected the 2nd motor to the driving shaft, since operation of a

prime mover is suspended and it drives only using the power by the 2nd motor, generally the thing in which the bigger torque output of the 2nd motor than the 1st motor is possible is needed. Since the torque output of a motor is proportional to the die length of the shaft orientations of Rota and it is proportional to the square of a diameter, the magnitude of the 2nd motor becomes larger than the 1st motor. As for magnitude required to output the same energy on the other hand, when an internal combustion engine is used for a prime mover, the direction of a prime mover becomes larger than a motor. Therefore, if a prime mover, the 1st motor, and the 2nd motor are arranged in order of magnitude, it will become the order of a prime mover, the 2nd motor, and the 1st motor. By arranging in order of such magnitude, the handling at the time of there being a settlement and carrying a power output unit in a car, a ship, etc. and an installation tooth space can be made advantageous.
[0014] Moreover, since a clutch etc. can constitute the 1st connecting means and 2nd connecting means as mentioned above, as compared with the 1st motor and 2nd motor, the magnitude is small. Therefore, it can also become possible to arrange the 1st connecting means and 2nd connecting means to the dead space formed among these big devices, and it can also make the whole equipment compacter.
[0015] In addition, in the power output unit which it comes to arrange in order of a prime mover, the 2nd motor, and the 1st motor, various arrangement is possible for the 1st connecting means and 2nd connecting means. As the technique of arranging the 1st connecting means and 2nd connecting means collectively, you may arrange between the 2nd above-mentioned motor and the 1st motor, and may arrange between a prime mover and the 2nd motor. While considering as the technique of arranging the 1st connecting means and 2nd connecting means separately and arranging the 1st connecting means between a prime mover and the 2nd motor, it is good also as what is arranged between the 2nd motor and the 1st motor.
[0016] Moreover, in the power output unit which comes to arrange a driving shaft, an output shaft, and a revolving shaft on the same axle, it shall come to arrange from said prime mover in order of said 1st motor and said 2nd motor. Various things are mentioned as mentioned above also as the technique of arrangement of the 1st connecting means in this case, and the 2nd connecting means. Thus, arrangement of a prime mover, the 1st motor, and the 2nd motor and arrangement of the 1st connecting means and the 2nd connecting means can be defined by a scale, a tooth space to install of a power output unit, and can be considered as various arrangement.
[0017] Moreover, in the power output unit of this invention, it shall come to arrange the revolving shaft of said 2nd motor on a different shaft from said driving shaft and said output shaft. If it carries out like this, as compared with what makes the whole of each shaft a same axle top, the die length of the shaft orientations of equipment can be made small.
[0018] Furthermore, in the power output unit of this invention, it shall come to arrange said output shaft and said driving shaft on a different shaft. In this case, further, it shall come to arrange the revolving shaft of said 2nd motor on said output shaft and same axle, or shall come to arrange the revolving shaft of said 2nd motor on said driving shaft and same axle. These power output units can also make the die length of the shaft orientations of equipment small as compared with what makes the whole of each shaft a same axle top.
[0019] Moreover, in the power output unit of this invention, said 1st connecting means shall be equipped with a gear change means to change gears and to transmit the rotational frequency of the revolving shaft of said 2nd motor to said output shaft, and said 2nd connecting means shall be equipped with the change gear which changes gears and transmits the rotational frequency of the revolving shaft of said 2nd motor to said driving shaft. If it carries out like this, the rotational frequency of a revolving shaft can be adjusted. Consequently, the 2nd motor can be operated on the more efficient point, and the effectiveness of equipment can be raised.
[0020] The power output units of this invention including these modifications shall be equipped with the connection control means which controls said the 1st connecting means and said 2nd connecting means based on the operational status of said prime mover, said 1st motor, said 2nd motor, and said driving shaft, or predetermined directions. If it carries out like this, the discharge can be performed in the connection list by the 1st connecting means and 2nd connecting means based on the condition of a prime

mover, the 1st motor, the 2nd motor, and a driving shaft, or predetermined directions.
[0021] In the power output unit of this invention equipped with such a connection control means said connection control means When it is in the condition as said operational status that the rotational speed of said output shaft is larger than the rotational speed of said driving shaft, Said 2nd connecting means is controlled so that this revolving shaft and said driving shaft are connected, while controlling said 1st connecting means so that connection between the revolving shaft of said 2nd motor and said output shaft is canceled. When it is in the condition as said operational status that the rotational speed of said output shaft is smaller than the rotational speed of said driving shaft, While controlling said 1st connecting means so that said the 2nd revolving shaft and said output shaft of a motor are connected, it shall be a means to control said 2nd connecting means so that connection between this revolving shaft and said driving shaft is canceled.
[0022] When the 2nd motor is connected to a driving shaft, and the rotational speed of a driving shaft is larger than the rotational speed of the output shaft of a prime mover, it is easy to produce circulation of power. In the above-mentioned invention, since the connection condition of the 2nd motor is controllable according to the rotational speed of a driving shaft, and the rotational speed of an output shaft, circulation of power can be reduced and the effectiveness of the whole equipment can be raised.
[0023] Moreover, in the power output unit of this invention equipped with a connection control means, said connection control means shall be a means to control said the 1st connecting means and said 2nd connecting means so that this revolving shaft and said output shaft are connected while said revolving shaft and said driving shaft are connected. If it carries out like this, the output shaft and driving shaft of a prime mover can be rotated in one, and the power outputted from a prime mover can be outputted to a direct-drive shaft at a rotational frequency as it is.
[0024] In the power output unit of such a mode, said operational status shall be in the condition of predetermined within the limits which can operate this prime mover efficiently, when the rotational frequency of said driving shaft is made into the rotational frequency of the output shaft of said prime mover. If it carries out like this, the power outputted from the prime mover operated efficiently can be outputted to a direct-drive shaft at a rotational frequency as it is.
[0025] Furthermore, in the power output unit of this invention equipped with a connection control means, said connection control means shall be a means to control said the 1st connecting means and said 2nd connecting means so that connection between this revolving shaft and said output shaft is canceled while connection between the revolving shaft of said 2nd motor and said driving shaft is canceled. If it carries out like this, the 2nd motor can be put on the outside of the system which outputs power to a driving shaft.
[0026] In the power output unit of such a mode, said operational status shall be in the condition of predetermined within the limits which can operate this prime mover efficiently, when the torque outputted to the condition in which an output is possible from said prime mover, without being accompanied by the change in the torque according the torque which should be outputted to a driving shaft to said 2nd motor is set up. If it carries out like this, the power outputted from the prime mover operated efficiently can be outputted to a direct-drive shaft. Moreover, said operational status shall be in the condition which detected the abnormalities of said 2nd motor. If it carries out like this, when the abnormalities of the 2nd motor are detected, rotation of the 2nd motor can be suspended.
[0027] Or in the power output unit of this invention equipped with a connection control means, when said revolving shaft is connected to either said output shaft or said driving shaft by said connection control means, it shall have the drive control means which carries out drive control of said the 1st motor and said 2nd motor so that torque conversion of the power outputted from said prime mover may be carried out and it may output to said driving shaft. If it carries out like this, torque conversion can be carried out and it can output to the power of a request of the power outputted from the prime mover at a driving shaft. Consequently, if it is the operation point which outputs the same energy, a prime mover can be operated on the more efficient operation point, and the energy efficiency of the whole equipment can be raised.
[0028] Moreover, the charge and discharge of the power consumed or revived in the power output unit

of this invention equipped with a connection control means in the case of an exchange of the power by said 1st motor, The accumulation-of-electricity means in which the charge and discharge of the power consumed or revived in the case of an exchange of the power by said 2nd motor are possible, A target power setting means to set up the target power which should be outputted to said driving shaft based on directions of an operator, The target power set up by said target power setting means It shall have the drive control means which carries out drive control of said prime mover, said 1st motor, and said 2nd motor so that it may be outputted to said driving shaft by the energy which consists of power by which charge and discharge are carried out with the power outputted from said prime mover, and said accumulation-of-electricity means.

[0029] The charge and discharge of the power consumed or revived in the case of an exchange of the power according [ an accumulation-of-electricity means ] to the 1st motor in the power output unit of this mode according to the need, The charge and discharge of the power consumed or revived in the case of an exchange of the power by the 2nd motor are performed. A drive control means with a target power setting means Drive control of a prime mover, the 1st motor, and the 2nd motor is carried out so that it may be outputted to a driving shaft by the energy which the target power set up as power which should be outputted to a driving shaft based on directions of an operator becomes from the power by which charge and discharge are carried out with the power outputted from a prime mover, and an accumulation-of-electricity means. Since torque conversion can be carried out and it can output to the power of a request of the energy which consists of power by which charge and discharge are carried out at a driving shaft with the power outputted from the power output unit, then prime mover of such a mode, and an accumulation-of-electricity means, even if bigger target power than the maximum power in which an output is possible is set up from a prime mover, this target power can be outputted to a driving shaft. For this reason, what can output only power smaller than the maximum target power which can be set up as a prime mover can be used. Consequently, the whole equipment can be miniaturized.

[0030] It has an accumulation-of-electricity condition detection means detect the condition of said accumulation-of-electricity means, and said drive control means shall be the means which carries out drive control of said prime mover, said 1st motor, and said 2nd motor so that the condition of said accumulation-of-electricity means detected by said accumulation-of-electricity condition detection means may be in the condition of predetermined within the limits in the power output unit of this invention equipped with such an accumulation-of-electricity means and a drive control means. Whenever it carries out like this, an accumulation-of-electricity means can be changed into the condition of predetermined within the limits.

[0031] In the power output unit of this invention equipped with an accumulation-of-electricity means and a drive control means moreover, said connection control means While controlling said 1st connecting means so that connection between the revolving shaft of said 2nd motor and said output shaft is canceled when there are predetermined directions of an operator, or when the target power set up by said target power setting means is the power of the predetermined range As this revolving shaft and said driving shaft are connected, it shall be a means to control said 2nd connecting means, and said drive control means shall be a means which carries out drive control of said 2nd motor using the power which discharges from said accumulation-of-electricity means. If it carries out like this, the rotation drive of the driving shaft can be carried out only under the power outputted from the 2nd motor.

[0032] In the power output unit of this invention equipped with an accumulation-of-electricity means and a drive control means or said connection control means While controlling said 1st connecting means so that said the 2nd revolving shaft and said output shaft of a motor are connected when there are predetermined directions of an operator, or when the target power set up by said target power setting means is the power of the predetermined range It is a means to control said 2nd connecting means so that connection between this revolving shaft and said driving shaft is canceled. Said drive control means While controlling this 1st motor using the power which discharges from said accumulation-of-electricity means to output power to a driving shaft from said 1st motor It shall be a means to control said 2nd motor to negate the torque which acts on the output shaft of said prime mover with the output of this

power. If it carries out like this, the rotation drive of the driving shaft can be carried out under the power outputted from the 1st motor.
[0033] In the power output unit of this invention equipped with an accumulation-of-electricity means and a drive control means furthermore, said connection control means While controlling said 1st connecting means so that said the 2nd revolving shaft and said output shaft of a motor are connected when there are predetermined directions of an operator, or when the target power set up by said target power setting means is the power of the predetermined range It is a means to control said 2nd connecting means so that this revolving shaft and said driving shaft are connected. Said drive control means While suspending the fuel supply to said prime mover, and control of ignition, and carrying out motoring of said prime mover using the power which discharges from said accumulation-of-electricity means, it shall be a means to control said 2nd motor to output power to said driving shaft. If it carries out like this, power can be outputted to a driving shaft with the 2nd motor, rotating a prime mover compulsorily.
[0034] In the power output unit of this invention of the mode which carries out motoring of this prime mover, when predetermined starting directions are made, it shall have the prime-mover starting control means which controls the fuel supply to this prime mover, and ignition in connection with motoring of said prime mover. If it carries out like this, a prime mover can be put into operation and it can shift to the mode which outputs power to a driving shaft from a prime mover and the 2nd motor easily.
[0035] And in the power output unit of this mode, said drive control means shall be a means to control said 2nd motor to negate the power outputted from this prime mover with starting of said prime mover by said prime-mover starting control means. If it carries out like this, fluctuation of the torque outputted to the driving shaft produced in the case of starting of a prime mover can be made small, or it can lose.
[0036] Moreover, in the power output unit of this invention equipped with an accumulation-of-electricity means and a drive control means, said target power setting means shall be a means to set up the power with which the output direction of shaft rotation of said prime mover makes the reverse sense rotate said driving shaft as target power. If it carries out like this, opposite orientation can be made to rotate a driving shaft with the output direction of shaft rotation of a prime mover.
[0037] Moreover, when predetermined inversion directions are made in the power output unit of this invention equipped with a connection control means, While controlling said the 1st and said 2nd connecting means so that connection between the revolving shaft of said 2nd motor and said output shaft is canceled through said connection control means and said revolving shaft and said driving shaft are connected It shall have the inversion control means which controls this 2nd motor to output the power rotated to the reverse sense with the output direction of shaft rotation of said prime mover to said driving shaft from said 2nd motor. If it carries out like this, the reverse sense can be made to rotate a driving shaft with the output direction of shaft rotation of a prime mover with the 2nd motor.
[0038] When predetermined inversion directions are made in the power output unit of this invention equipped with a connection control means, While controlling said the 1st and said 2nd connecting means so that said the 2nd revolving shaft and said output shaft of a motor are connected through said connection control means and connection between this revolving shaft and said driving shaft is canceled This 2nd motor is controlled to output the power rotated to the reverse sense with the output direction of shaft rotation of said prime mover to said driving shaft from said 1st motor. It shall have the inversion control means which controls said 2nd motor to negate the torque which acts on said output shaft as reaction force of the power outputted to this driving shaft. If it carries out like this, the reverse sense can be made to rotate a driving shaft with the output direction of shaft rotation of a prime mover with the 1st motor.
[0039] When predetermined starting directions are made in the power output unit of this invention equipped with a connection control means, While controlling said 1st and 2nd connecting means so that said the 2nd revolving shaft and said output shaft of a motor are connected through said connection control means and connection between this revolving shaft and said driving shaft is canceled It shall have the prime-mover starting control means which controls said 2nd motor to carry out motoring of said prime mover, and controls the fuel supply to this prime mover, and ignition in connection with

motoring of this prime mover. A prime mover can be put into operation with the 2nd motor, without establishing separately the motor for putting a prime mover into operation, if it carries out like this.
[0040] When predetermined starting directions are made in the power output unit of this invention equipped with a connection control means, While controlling said 1st and 2nd connecting means so that connection between the revolving shaft of said 2nd motor and said output shaft is canceled through said connection control means and this revolving shaft and said driving shaft are connected It shall have the prime-mover starting control means which controls this 2nd motor so that said revolving shaft does not rotate, controls said 1st motor to carry out motoring of said prime mover, and controls the fuel supply to this prime mover, and ignition in connection with motoring of this prime mover further. A prime mover can be put into operation with the 1st motor and 2nd motor, without establishing separately the motor for putting a prime mover into operation, if it carries out like this.
[0041] Where connection between the revolving shaft of said 2nd motor and said output shaft was canceled and this revolving shaft and said driving shaft are connected in the power output unit of this invention equipped with a connection control means, when outputting power to said driving shaft from said 2nd motor and predetermined starting directions are made, While controlling said 1st motor to carry out motoring of said prime mover, it shall have the prime-mover starting control means which controls the fuel supply to this prime mover, and ignition in connection with motoring of this prime mover. If it carries out like this, the midst which is driving the driving shaft with the 2nd motor can also put a prime mover into operation. From the first, it is not necessary to establish separately the motor for putting a prime mover into operation.
[0042] In the power output unit of this mode, said prime-mover starting means shall be a means to control said 2nd motor to negate the torque outputted to said driving shaft from said 1st motor as reaction force of the torque which motoring of said prime mover takes. If it carries out like this, torque fluctuation produced in a driving shaft can be made smaller.
[0043] In the power output unit of this invention equipped with a connection control means Where said the 2nd revolving shaft and said output shaft of a motor were connected and connection with said revolving shaft and said driving shaft is canceled, while fixing said output shaft with said 2nd motor, when outputting power to said driving shaft from said 1st motor and predetermined starting directions are made, It shall have the prime-mover starting control means which controls said 2nd motor to carry out motoring of said prime mover, and controls the fuel supply to this prime mover, and ignition in connection with motoring of this prime mover. If it carries out like this, the midst which is driving the driving shaft with the 1st motor can also put a prime mover into operation. From the first, it is not necessary to establish separately the motor for putting a prime mover into operation.
[0044] In the power output unit of this mode, said prime-mover starting means shall be a means to control said 1st motor to negate the torque outputted to said driving shaft as reaction force of the torque which motoring of said prime mover takes. If it carries out like this, torque fluctuation produced in a driving shaft can be made smaller.
[0045] The prime mover by which the control approach of the 1st power output unit of this invention has an output shaft, The 1st shaft combined with said output shaft, and the 2nd shaft combined with said driving shaft, The power means of communication with which the power outputted and inputted by one residual shaft will be determined if the power which has the 3rd different shaft from this 1st shaft and the 2nd shaft, and is outputted and inputted by two shafts among these is determined, The 1st motor combined with said 3rd shaft, and the 2nd motor which has a different revolving shaft from said output shaft and said driving shaft, and exchanges power through this revolving shaft, The 1st connecting means which performs mechanical connection with said revolving shaft and said output shaft, and discharge of this connection, It is the control approach of the power output unit which is equipped with the 2nd connecting means which performs mechanical connection with said revolving shaft and said driving shaft, and discharge of this connection, and outputs power to said driving shaft. When the rotational speed of said output shaft is larger than the rotational speed of said driving shaft, Said 2nd connecting means is controlled so that this revolving shaft and said driving shaft are connected, while controlling said 1st connecting means so that connection between the revolving shaft of said 2nd motor

and said output shaft is canceled. When the rotational speed of said output shaft is smaller than the rotational speed of said driving shaft, while controlling said 1st connecting means so that said revolving shaft and said output shaft are connected, let it be a summary to control said 2nd connecting means so that connection between this revolving shaft and said driving shaft is canceled.

[0046] The prime mover by which the control approach of the 2nd power output unit of this invention has an output shaft, The 1st shaft combined with said output shaft, and the 2nd shaft combined with said driving shaft, The power means of communication with which the power outputted and inputted by one residual shaft will be determined if the power which has the 3rd different shaft from this 1st shaft and the 2nd shaft, and is outputted and inputted by two shafts among these is determined, The 1st motor combined with said 3rd shaft, and the 2nd motor which has a different revolving shaft from said output shaft and said driving shaft, and exchanges power through this revolving shaft, The 1st connecting means which performs mechanical connection with said revolving shaft and said output shaft, and discharge of this connection, It has the 2nd connecting means which performs mechanical connection with said revolving shaft and said driving shaft, and discharge of this connection. If it is the control approach of the power output unit which outputs power to said driving shaft and the rotational frequency of said driving shaft is made into the rotational frequency of the output shaft of said prime mover, when this prime mover will be in the condition of predetermined within the limits which can be operated efficiently, While said the 2nd revolving shaft and said driving shaft of a motor are connected, let it be a summary to control said the 1st connecting means and said 2nd connecting means so that this revolving shaft and said output shaft are connected.

[0047] In the control approach of such 1st or 2nd power output unit said power output unit The charge and discharge of the power consumed or revived in the case of an exchange of the power by said 1st motor, It has the accumulation-of-electricity means in which the charge and discharge of the power consumed or revived in the case of an exchange of the power by said 2nd motor are possible. The control approach of said power output unit Furthermore, the target power setting step which sets up the target power which should be outputted to said driving shaft based on directions of an operator, The set-up this target power It shall have the drive control step which carries out drive control of said prime mover, said 1st motor, and said 2nd motor so that it may be outputted to said driving shaft by the energy which consists of power by which charge and discharge are carried out with the power outputted from said prime mover, and said accumulation-of-electricity means.

[0048] According to the control approach of this mode, since torque conversion can be carried out and it can output to the power of a request of the energy which consists of power by which charge and discharge are carried out at a driving shaft with the power outputted from a prime mover, and an accumulation-of-electricity means, even if bigger target power than the maximum power in which an output is possible is set up from a prime mover, this target power can be outputted to a driving shaft. For this reason, what can output only power smaller than the maximum target power which can be set up as a prime mover can be used. In such a control approach, said drive control step shall be a step which carries out drive control of said prime mover, said 1st motor, and said 2nd motor so that the condition of said accumulation-of-electricity means may be detected and the condition of this accumulation-of-electricity means may be in the condition of predetermined within the limits further. Whenever it carries out like this, an accumulation-of-electricity means can be changed into the condition of predetermined within the limits.

[0049] The prime mover by which the control approach of the 3rd power output unit of this invention has an output shaft, The 1st shaft combined with said output shaft, and the 2nd shaft combined with said driving shaft, The power means of communication with which the power outputted and inputted by one residual shaft will be determined if the power which has the 3rd different shaft from this 1st shaft and the 2nd shaft, and is outputted and inputted by two shafts among these is determined, The 1st motor combined with said 3rd shaft, and the 2nd motor which has a different revolving shaft from said output shaft and said driving shaft, and exchanges power through this revolving shaft, The 1st connecting means which performs mechanical connection with said revolving shaft and said output shaft, and discharge of this connection, It has the 2nd connecting means which performs mechanical connection

with said revolving shaft and said driving shaft, and discharge of this connection. Are the control approach of the power output unit which outputs power to said driving shaft, and this 1st connecting means and this 2nd connecting means are controlled to perform connection by said 1st connecting means, or connection by said 2nd connecting means. Let it be a summary to carry out drive control of said the 1st motor and said 2nd motor so that torque conversion of the power outputted from said prime mover may be carried out and it may output to said driving shaft.

[0050]

[Embodiment of the Invention] A. Explain the gestalt of operation of this invention based on an example below a configuration. Drawing 1 is the block diagram showing the outline configuration of the power output unit 20 as the 1st example of this invention. This car is equipped with the gasoline engine operated with a gasoline as an engine 50 which is a source of power so that it may illustrate. This engine 50 inhales the gaseous mixture of the air inhaled from the inhalation-of-air system, and the gasoline injected from the fuel injection valve 51 to a combustion chamber 52, and changes into rotation of a crankshaft 56 movement of the piston 54 depressed by explosion of this gaseous mixture. An ignition plug 62 forms a spark with the high voltage drawn through the distributor 60 from the ignitor 58, and gaseous mixture is lit by the spark and carries out explosion combustion of it by it.

[0051] Operation of this engine 50 is controlled by the electronic control unit (hereafter referred to as EFIECU) 70. The various sensors in which the operational status of an engine 50 is shown are connected to EFIECU70. For example, it is the rotational frequency sensor 76, the angle-of-rotation sensor 78, etc. which are prepared for the coolant temperature sensor and distributor 60 which detect the water temperature of the throttle-valve position sensor which detects the opening (position) of a throttle valve, the inlet-pipe negative pressure sensor which detects the load of an engine 50, and an engine 50, and detect the rotational frequency and angle of rotation of a crankshaft 56. In addition, although the starting switch 79 which detects the condition ST of an ignition key was connected to EFIECU70 in addition to this, illustration of other sensors, a switch, etc. was omitted.

[0052] The driving shaft 22 is combined with the crankshaft 56 of an engine 50 through the motors MG1 and MG2 and planetary-gear 220 grade which are mentioned later. The driving shaft 22 is combined with the differential gear 24, and, finally the torque from the power output unit 20 is transmitted to the driving wheels 26 and 28 on either side. These motors MG1 and MG2 are controlled by the control unit 80. Although the configuration of a control unit 80 is explained in full detail later, the interior is equipped with Control CPU and accelerator pedal position sensor 64a prepared in the shift position sensor 84 formed in the shift lever 82 or the accelerator pedal 64, brake-pedal position sensor 65a prepared in the brake pedal 65 are connected. Moreover, the control unit 80 is exchanging various information by EFIECU70 and the communication link which were mentioned above. About control including the exchange of such information, it mentions later.

[0053] The power output unit 20 consists of a motor MG 2 by which Rota 41 is mechanically connected to a crankshaft 56 or a driving shaft 22 by an engine 50, the planetary gear 200 combined with a motor MG 1, both, and a driving shaft 22, and the 1st clutch 45 and the 2nd clutch 46, and a control unit 80 which controls these operations.

[0054] Planetary gear 200 consist of planetary carriers 223 equipped with the PURANETARIPINI demon gear 223 which revolves around the sun while rotating between a ring wheel 222, and the sun gear 221 and ring wheel 222 which it is arranged the sun gear 221 and sun gear 221 which rotate at the core, and concentric circular, and are rotated around a sun gear 221. The sun gear shaft 225 combined with the sun gear 221 is combined with Rota 31 of a motor MG 1. While being combined with a driving shaft 22 through the power extract gear 228 and the power transfer belt 229, Rota of a motor MG 2 and association with the 2nd clutch 46 are possible for the ring wheel shaft 227. While being combined with a crankshaft 45, Rota of a motor MG 2 and association with the 1st clutch 45 are possible for the planetary carrier shaft 226.

[0055] As shown in drawing 1 , a motor MG 1 equips the peripheral face of Rota 31 with eight permanent magnets, and is constituted as a synchronous motor which winds the coil of a three phase around 12 slots formed in the stator 33. The stator 33 and the body of Rota 31 consist of carrying out the

laminating of the sheet metal of a non-oriented magnetic steel sheet, respectively. The permanent magnet stuck on Rota 31 is arranged so that N pole and the south pole may appear in a peripheral face by turns. If the three-phase alternating current is passed in the coil of a stator 33, rotating magnetic field will be produced. A motor MG 1 rotates by the interaction of this rotating magnetic field and the next time which the permanent magnet stuck on Rota 31 forms. Moreover, a motor MG 1 functions also as a generator which generates electricity using the electromotive force produced in the coil of a stator 33 by rotation of Rota 31.

[0056] The motor MG 2 consists of the stators 43 and Rota 42 which have the same configuration as a motor MG 1. It rotates by the interaction of the rotating magnetic field produced with the coil of a stator 43, and the field which the permanent magnet stuck on Rota 41 forms, and also a motor MG 2 functions as a generator. The revolving shaft of Rota 41 of a motor MG 2 is mechanically connected to a crankshaft 56 by the 1st clutch 45 arranged between planetary gear 200 and a motor MG 1, or the connection is canceled. Moreover, the 2nd clutch 46 connects with the ring wheel shaft 227 of planetary gear 200 mechanically, or the connection is canceled. In addition, the 1st clutch 45 and the 2nd clutch 46 operate by the hydraulic circuit which is not illustrated.

[0057] In addition, although not illustrated in drawing 1 , the resolver which detects angle-of-rotation thetad, thetar, and thetae is prepared in the driving shaft 22, the Rota revolving shaft 38, and the crankshaft 56. The resolver which detects angle-of-rotation thetae of a crankshaft 56 can also be used also [ sensor / 78 / which was prepared for the distributor 60 / angle-of-rotation ].

[0058] Although the arrangement used as a motor MG 2 and a motor MG 1 from an engine 50 side is also possible so that arrangement of motors MG1 and MG2 may be mentioned later Having arranged the motor MG 1 in the middle of an engine 50 and a motor MG 2 like the power output unit 20 of an example It is because there shall be a settlement by the power output unit 20 by making the big motor MG 2 adjoin the bigger engine 50 from the need of driving a car by the motor MG 2 so that it may mention later, since a motor MG 2 becomes large as compared with a motor MG 1. Moreover, various arrangement is possible so that arrangement of the 1st clutch 45 and the 2nd clutch 46 may also be mentioned later, but since both [ these ] the clutches 45 and 46 are comparatively small, it has arranged between a motor MG 1 and a motor MG 2 like the power output unit 20 of an example for putting into the clearance produced between a motor MG 1 and a motor MG 2, and making the power output unit 20 compacter.

[0059] Next, a control unit 80 is explained. A control unit 80 consists of control CPU 90 which carries out drive control of the 1st clutch 45 and the 2nd clutch 46, and a dc-battery 94 which is a rechargeable battery while controlling the 1st drive circuit 91 which drives a motor MG 1, the 2nd drive circuit 92 which drives a motor MG 2, and both the drive circuits 91 and 92. Control CPU 90 is one chip microprocessor, and although not illustrated, it equips the interior with RAM for work pieces, ROM which memorized the processing program, input/output port and EFIECU70, and the serial communication port that performs a communication link. Angle-of-rotation thetad of a driving shaft 22, angle-of-rotation thetar of Rota 41 of a motor MG 2, and angle-of-rotation thetae of an engine 50 are inputted into this control CPU 90 from each resolver. Moreover, the accelerator pedal position AP from accelerator pedal position sensor 64a (the amount of treading in of an accelerator pedal) The brake-pedal position BP from brake-pedal position sensor 65a (the amount of treading in of a brake pedal 65), The on-off signal of both the clutches from the shift position SP, the 1st clutch 45, and the 2nd clutch 46 from the shift position sensor 84, The remaining capacity BRM from the remaining capacity detector 99 which detects the values Iuc and Ivc of the current which flows in the 1st drive circuit 91, the values Iua and Iva of the current which flows in the 2nd drive circuit, and the remaining capacity of a dc-battery 94 is inputted through input port. In addition, what the remaining capacity detector 99 measures the specific gravity of the electrolytic solution of a dc-battery 94 or the weight of the whole dc-battery 94, and detects remaining capacity, the thing which calculates the current value and time amount of charge and discharge, and detects remaining capacity, the thing which detects remaining capacity by acting as Short of between the terminals of a dc-battery momentarily, and measuring sink internal resistance for a current are known.

[0060] Moreover, from control CPU 90, the driving signal which drives the control signal which drives six transistors which are the switching elements prepared in the 1st drive circuit 91, the control signal which drives six as a switching element prepared in the 2nd drive circuit 92, the 1st clutch 45, and the 2nd clutch 46 is outputted. Six transistors in the 1st drive circuit 91 constitute the transistor inverter, and while two pieces are arranged at a time in a pair so that it may become a source and sink side to power-source Rhine of a pair, respectively, each of the three phase coil (UVW) of a motor MG 1 is connected at the node. Power-source Rhine is connected to the plus [ of a dc-battery 94 ], and minus side, respectively. The rate of the ON time amount of a transistor of making a pair by control CPU 90 is controlled sequentially, and if the current which flows in each coil is made into a false sine wave by PWM control, rotating magnetic field will be formed with a three phase coil. Six transistors of the 2nd drive circuit 92 also constitute the transistor inverter, and can form rotating magnetic field similarly.
[0061] B. Explain actuation of the power output unit 20 of the example which explained the configuration more than the principle of operation. In addition, the following explanation explains it, assuming the transmission efficiency of the power in equipment to be what is 100%. Fundamental actuation of planetary gear 200 is explained first. Although it is the thing of common knowledge on device study, planetary gear 200 have the property in which the power of one residual revolving shaft is determined, if the power of two revolving shafts is determined among three revolving shafts, the sun gear shaft 225, the ring wheel shaft 227, and the planetary carrier shaft 226. The rotational frequency of each revolving shaft and the relation of torque are shown by the degree type (1).
[0062]
Nr= (1+rho) Nc-rho Ns;
Nc=(Nr+rho Ns)/(1+rho);
Ns= (Nc-Nr) / rho+Nc;
Ts=rho / (1+rho) xTc;
Tr=1-/(1+rho) xTc -- (1)
[0063] Ns and Ts are the rotational frequencies and torque of the sun gear shaft 225, Nr and Tr are the rotational frequencies and torque of the ring wheel shaft 227 here, and Nc and Tc are the rotational frequencies and torque of the planetary carrier shaft 226. Moreover, rho is the gear ratio of a sun gear 221 and a ring wheel 222 as it is expressed with a degree type. The number of teeth of the number of teeth / ring wheel 222 of the rho= sun gear 221 [0064] The case (it is hereafter called undershirt drive association) where made the 1st clutch 45 off and the 2nd clutch 46 is set to ON, and the case (it is hereafter called overdrive association) where set the 1st clutch 45 to ON conversely, and the 2nd clutch 46 is made off are considered. the former is shown in the mimetic diagram of drawing 2 -- as -- a motor MG 2 -- a ring wheel 222 -- getting it blocked -- it is equivalent to the configuration attached in the driving shaft 22. The latter is equivalent to the configuration which attached the motor MG 2 in the crankshaft 56, as shown in the mimetic diagram of drawing 3 .
[0065] First, the former (when the 1st clutch 45 was made off and the 2nd clutch 46 is set to ON) actuation is explained. The principle of operation in this case, especially the principle of torque conversion are as follows. The situation of the torque conversion to drawing 4 is shown. An engine 50 shall be operated with the point Ne equivalent to P0 in drawing 4 , i.e., a rotational frequency, and Torque Te, and the point Nd1 equivalent to P1 in drawing 4 , i.e., a rotational frequency, and the power which becomes torque Td1 shall be outputted from the driving shaft 22. It is referred to as Nd1 <Ne and Td1> Te. Moreover, the magnitude of power is both and let it be equals. That is, it considers as Nd1xTd1=NexTe.
[0066] When the ring wheel shaft 227 combined with the driving shaft 22 is rotating at the engine speed Nd1 and the power mentioned above from the engine 50 is outputted, the sun gear shaft 225 rotates with the engine speed Ns and Torque Ts which are searched for by the upper formula (1). Moreover, the torque Tr similarly searched for by the top formula (1) will be outputted from the ring wheel shaft 227. Naturally, Torque Tr is smaller than the torque Te outputted from an engine 50.
[0067] Since Rota 31 of a motor MG 1 is rotating by rotation of the sun gear shaft 225, if the control CPU 90 of a control device 80 outputs a control signal and switches the transistor of the drive circuit 91,

a motor MG 1 will function as a generator. The power equivalent to NsxTs is revived by the motor MG 1. On the other hand, if power is supplied and it acts as the power running of the motor MG 2, torque can be added to the ring wheel shaft 227. If the electric energy supplied to a motor MG 2 is controlled, the torque equivalent to the difference of the torque Tr outputted to the ring wheel shaft 227 from an engine 50 and the torque Td1 which should be outputted from a driving shaft 22 can be added by the motor MG 2. under the present circumstances, the power which should be supplied to a motor MG 2 -- an upper type (1) and Nd1xTd1=NexTe -- based on relation, it is easily computable. The value becomes equal to power NsxTs revived by the motor MG 1.

[0068] That is, by supplying the power revived by the motor MG 1 to a motor MG 2, a rotational frequency and torque can be changed without changing the magnitude for the power outputted from the engine 50, and it can output from a driving shaft 22.

[0069] Next, an engine 50 is operated on the above-mentioned operation point P0, and the case where the power Nd2 which is equivalent to the point P2 in drawing 4 from a driving shaft 22, i.e., a bigger rotational frequency than a rotational frequency Ne, and the power which wears and consists of torque Td2 smaller than Torque Te are outputted is considered. In order to rotate the ring wheel shaft 227 at a rotational frequency higher than an engine 50 at this time, power is supplied to a motor MG 1, it will act as the power running of the motor MG 1, and it will be accelerated. On the other hand, the operation point P2 is enough if torque lower than the torque Te outputted from an engine 50 is outputted. As a result of acting as the power running of the motor MG 1 and accelerating rotation of the ring wheel shaft 227, from the ring wheel shaft 227, torque higher than the demand torque Td2 is outputted. Therefore, it generates electricity by the motor MG 2, and excessive torque is revived as power. This power is used for the power running of a motor MG 1. Like the case where the power which is equivalent to the point P1 from a driving shaft 22 is outputted, if an upper type (1) etc. is taken into consideration, the power revived by the motor MG 2 and the power supplied to a motor MG 1 are equal. Since a part of power outputted by the power running of a motor MG 1 is again revived by the motor MG 2, circulation of power will produce it at this time.

[0070] If the above actuation is summarized, in undershirt drive association, by carrying out regeneration operation of the motor MG 1 as the 1st operation mode, and carrying out power running of the motor MG 2, a rotational frequency can change into the low high condition of torque the power outputted from an engine 50, and the power output unit 20 can output it from a driving shaft 22. Moreover, by carrying out power running of the motor MG 1 as the 2nd operation mode, and carrying out regeneration operation of the motor MG 2, a rotational frequency can change into the low high condition of torque the power outputted from an engine 50, and can output it from a driving shaft 22. Circulation of power is not produced in the 1st operation mode, but circulation of power arises in the 2nd operation mode.

[0071] On the other hand, the principle of operation (principle of torque conversion) in overdrive association (mimetic diagram of drawing 3 ) is as follows. Now, the engine 50 is operated on the operation point P0 of a rotational frequency Ne and Torque Te, and suppose that it is rotating in the condition that a driving shaft 22 is equivalent to the point P1. If torque is outputted to a crankshaft 56 from the motor MG 2 attached in the crankshaft 56, the torque of the planetary carrier shaft 226 will turn into bigger torque than output-torque Te from an engine 50. If the magnitude of this addition torque is controlled, it is controllable so that the magnitude of the torque outputted from the ring wheel shaft 227 based on an upper type (1) serves as the demand torque Td1. On the other hand, since a part of power inputted from the planetary carrier shaft 226 at this time is distributed by planetary gear 200 and it is transmitted to the sun gear shaft 225, it can revive this power as power by the motor MG 1. This power is used for the power running of a motor MG 2. Both power becomes equal like the case of undershirt drive association. Since a part of power outputted by the power running of a motor MG 2 is revived as power by the motor MG 1, circulation of power will have produced it at this time.

[0072] Next, an engine 50 is operated on the operation point P0, and the case where the power which is equivalent to the point P2 from a driving shaft 22 is outputted is considered. At this time, demand power is small compared with the power Te outputted from an engine 50. Therefore, regeneration operation of

the motor MG 2 can be carried out, and the demand power Td2 can be outputted from the ring wheel shaft 227 by giving a load to the planetary carrier shaft 226. On the other hand, since the rotational frequency of the ring wheel shaft 227 is increased, it is necessary to act as the power running of the motor MG 1. The power revived by the motor MG 2 is used for the power running of a motor MG 1. Both power becomes equal like the case of undershirt drive association.

[0073] If the above actuation is summarized, as the 1st operation mode, by carrying out regeneration operation of the motor MG 1, and carrying out power running of the motor MG 2, a rotational frequency can change into the low high condition of torque the power outputted from an engine 50, and the power output unit 20 can output it from a driving shaft 22 in overdrive association. Moreover, by carrying out power running of the motor MG 1 as the 2nd operation mode, and carrying out regeneration operation of the motor MG 2, a rotational frequency can change into the low high condition of torque the power outputted from an engine 50, and can output it from a driving shaft 22. Circulation of power arises in the 1st operation mode, and circulation of power does not arise in the 2nd operation mode.

[0074] In addition, the power outputted from an engine 50 besides the actuation which the power output unit 20 carries out torque conversion of all the power outputted from the engine 50 explained above, and is outputted to a driving shaft 22 (product of Torque Te and a rotational frequency Ne), Various actuation, such as actuation which supplies the power which charges a dc-battery 94 or is insufficient in excessive power from a dc-battery 94, can also be carried out by adjusting the electrical energy revived or consumed by motors MG1 and MG2.

[0075] C. Explain a setup of operation-control (1) operation mode, next the operation control of the power output unit 20 constituted in this way based on the operation control routine illustrated to drawing 5 . An operation control routine is repeatedly performed for every (every [ for example, ] 8msec) predetermined time, after the directions which start transit of a car are made. If an operation control routine is performed, the control CPU 90 of a control unit 80 will perform processing which inputs the rotational frequency Nd of a driving shaft 22 first (step S100). It can ask for the engine speed Nd of a driving shaft 22 from angle-of-rotation thetad of the driving shaft 22 read from the resolver. Next, the accelerator pedal position AP detected by accelerator pedal position sensor 64a is read (step S102). Since an accelerator pedal 64 is broken in when it senses that an operator's output torque is insufficient, the accelerator pedal position AP corresponds to the output torque (namely, torque which should be outputted to a driving shaft 22) which the operator wants.

[0076] Then, processing which derives torque command value Td* which is the desired value of the torque which should be outputted to a driving shaft 22 based on the read accelerator pedal position AP and the rotational frequency Nd of a driving shaft 22 is performed (step S104). In the example, the map in which torque command value Td*, the engine speed Nd of a driving shaft 22, and relation with the accelerator pedal position AP are shown is beforehand memorized to ROM in control CPU 90, and if the accelerator pedal position AP is read, the value of torque command value Td* which corresponds at a map, and the read accelerator pedal position AP and the engine speed Nd of a driving shaft 22 shall be derived. An example of this map is shown in drawing 6 .

[0077] Next, the energy Pd which should be outputted to a driving shaft 22 from drawn torque command value Td* and the rotational frequency Nd of the read driving shaft 22 is searched for by count (Pd=Td*xNd) (step S106). Then, processing which reads the remaining capacity BRM of the dc-battery 94 detected by the remaining capacity detector 99 is performed, and judgment processing of operation mode is performed (step S110). Judgment processing of this operation mode is processed by the operation mode judging manipulation routine illustrated to drawing 7 . In an operation mode judging manipulation routine, the more suitable operation mode of the power output unit 20 at that time is judged using the data read by step S100 of an operation control routine thru/or S108, the calculated data. Here, explanation of the operation control routine of drawing 5 is once interrupted, and judgment processing of operation mode is previously explained based on the operation mode judging manipulation routine of drawing 7 .

[0078] If an operation mode judging manipulation routine is performed, it will judge it that the charge and discharge of a dc-battery 94 are required when it judges (step S130) and there is nothing within the

limits of this whether there is control CPU 90 of a control device 80 within limits to which the remaining capacity BRM of a dc-battery 94 is expressed with a threshold BL and a threshold BH, and charge-and-discharge mode will be set up as operation mode of the power output unit 20 (step S132). Here, a threshold BL and a threshold BH show the lower limit and upper limit of remaining capacity BRM of a dc-battery 94, and a threshold BL is set up in the example as a value beyond electric energy required to carry out predetermined time continuation and perform drive by the motor MG 2 by the below-mentioned motor drive mode, addition of the power by the discharge power from the dc-battery 94 by power assistant mode, etc. Moreover, in case a threshold BH suspends the car which is usually in a run state from the remaining capacity BRM at the time of the full charge of a dc-battery 94, it is set below to the value which reduced the electric energy revived by the motor MG 1 and the motor MG 2.
[0079] When it is within limits to which the remaining capacity BRM of a dc-battery 94 is expressed with step S130 with a threshold BL and a threshold BH, it judges whether the energy Pd which should be outputted to a driving shaft 22 is over the maximum energy Pemax in which an output is possible from the engine 50 (step S134). When Energy Pd is over maximum energy Pemax, in maximum energy Pemax outputted from an engine 50, it judges that the energy running short needs to provide meals with the energy stored in the dc-battery 94, and power assistant mode is set up as operation mode of the power output unit 20 (step S136).
[0080] On the other hand, the energy Pd which should be outputted to a driving shaft 22 judges whether torque command value Td* and a rotational frequency Nd are within the limits of predetermined from an engine 50 at the time of below the maximum energy Pemax in which an output is possible (step S138), and sets up the direct-output mode in the condition of having set the 1st clutch 45 and the 2nd clutch 46 to ON as operation mode of the power output unit 20, at both the times of predetermined within the limits (step S140). Here, the predetermined range is range which can operate an engine 50 efficiently where both the clutches 45 and 46 are turned ON. It will be judged whether the operation point which specifically memorizes to ROM beforehand by using the proper range as a map controlling as direct-output mode among the operation points of an engine 50, and is expressed with torque command value Td* and a rotational frequency Nd is in this proper range. An example of the proper range at the time of controlling as direct-output mode of an engine 50 is shown in drawing 8 . Among drawing, Field PE is a field which can operate an engine 50, and Field PA is the proper range at the time of controlling as direct-output mode. In addition, this proper range PA is appointed by effectiveness, emission, etc. of an engine 50, and can be beforehand set up by experiment etc.
[0081] At step S138, when there are not torque command value Td* and the rotational frequency Nd of a driving shaft 22 within the limits of predetermined The energy Pd which should be outputted to a driving shaft 22 is smaller than the predetermined energy PML. And it judges whether the rotational frequency Nd of a driving shaft 22 is smaller than the predetermined rotational frequency NML (step S142), and both, when small, the motor drive mode of the drive by the motor MG 2 is set up as operation mode of the power output unit 20 (step S144). An engine 50 sets up the range based on effectiveness falling with low torque at a low engine speed, and the predetermined energy PML and the predetermined engine speed NML are set up as the energy Pd which serves as a field of under predetermined effectiveness as a operating range of an engine 50, and an engine speed Nd. In addition, a concrete value is defined with the property of an engine 50 etc. At step S142, Energy Pd is beyond the predetermined energy PML, or it is judged as what performs the usual operation when a rotational frequency Nd is more than the predetermined rotational frequency NML, and operation mode is usually set up as operation mode of the power output unit 20 (step S146).
[0082] Return to step S110 of the operation control routine of drawing 5 , and it is based on the result of an operation mode judging manipulation routine. When operation mode is usually set up as operation mode, usually operation torque control processing (step S112) When charge-and-discharge mode is set up, charge-and-discharge torque control processing (step S114) When power assistant mode is set up, power assistant torque control processing (step S116) When direct-output mode is set up and motor drive mode is set up in direct-output torque control processing (step S118), motor driving torque control processing (step S120) is performed, respectively. In addition, it performs repeatedly for every (every

[ for example, ] 4msec(s)) predetermined time to timing different separately [ the torque control routine of the operation mode set up when, as for each torque control processing, operation mode was set up by the operation mode judging manipulation routine, although the example indicated each / the convenience tops of illustration, and / these / torque control processing as a step of an operation control routine ] from an operation control routine independently from an operation control routine. Hereafter, each torque control processing is explained.

[0083] (2) Usually, operation torque control processing usual operation torque control processing (step S112 of drawing 5 ) is made by the usual operation torque control routine illustrated to drawing 9 and drawing 10 . If this routine is performed, the control CPU 90 of a control device 80 will perform processing which reads the engine speed Nd of a driving shaft 22, and the engine speed Ne of an engine 50 first (steps S150 and S152). It can also ask for the engine speed Ne of an engine 50 from angle-of-rotation thetae of the crankshaft 56 detected by the resolver prepared in the crankshaft 56, and it can also carry out direct detection also by the engine-speed sensor 76 prepared for the distributor 60. When using the rotational frequency sensor 76, the information on a rotational frequency Ne will be received from EFIECU70 connected to the rotational frequency sensor 76 by communication link. And the engine-speed difference Nc of both shafts is searched for by count (Nc=Ne-Nd) from the engine speed Nd of the driving shaft 22 read in this way, and the engine speed Ne of an engine 50 (step S154).

[0084] Then, the energy Pd calculated at step S106 of the operation control routine of drawing 5 is compared with the energy Pd (it is called the last energy Pd) used when this routine was started last time (step S156). Here, last time, the thing when performing just before [ when usual operation torque control processing of step S112 is continuously performed by the operation control routine of drawing 5 ] is said. When Energy Pd differs from the last energy Pd, target torque Te* of an engine 50, target rotational frequency Ne*, and torque command value Tc* of a motor MG 1 are set up by step S170 shown in drawing 10 thru/or processing of S188, and when the energy Pd of last time [ Energy / Pd ] is the same, torque command value Tc* of a motor MG 1 is set up by processing of steps S158 and S160 shown in drawing 10 . First, processing in case Energy Pd differs from the last energy Pd is explained, and processing when the same is explained after that.

[0085] When Energy Pd differs from the last energy Pd, processing which sets up target torque Te* of an engine 50 and target rotational frequency Ne* first based on the energy Pd which should be outputted to a driving shaft 22 is performed (step S170). Here, since the energy outputted from an engine 50 is equal to the product of the torque Te of an engine 50, and an engine speed Ne when all the energy Pd that should be outputted to a driving shaft 22 shall be supplied with an engine 50, the relation between target torque Te* of the output energy Pd and an engine 50 and target engine-speed Ne* becomes Pd=Te*xNe*. However, the combination of target torque Te* of an engine 50 and target rotational frequency Ne* which satisfy this relation exists innumerably. So, in an example, an engine 50 is operated in the condition that effectiveness is high as much as possible, to each energy Pd. And the combination of target torque Te* and target rotational frequency Ne* from which the operational status of an engine 50 changes smoothly to change of Energy Pd is searched for by experiment etc. This shall be beforehand memorized as a map to ROM, and the combination of target torque Te* and target rotational frequency Ne* corresponding to Energy Pd shall be derived from this map. This map is explained further.

[0086] Drawing 11 is a graph which shows the relation between the operation point of an engine 50, and the effectiveness of an engine 50. The curve B in drawing shows the boundary of the field which can operate an engine 50. it is like [ the field which can operate an engine 50 ] the curve alpha 1 which shows the operation point with the same effectiveness according to the property thru/or alpha 6 -- etc. -- an effectiveness line can be drawn. Moreover, the curve 1 with the fixed energy expressed with the product of Torque Te and a rotational frequency Ne, for example, curvilinear C1-C, and C3-C3 can be drawn on the field which can operate an engine 50. In this way, if the drawn energy Pe expresses the rotational frequency Ne of an engine 50 for the effectiveness of each operation point as an axis of abscissa along with fixed curvilinear C1-C1 thru/or C3-C3, it will become like the graph of drawing 12 .

[0087] But the effectiveness of an engine 50 differs greatly by on which operation point it operates with the same energy Pe outputted from an engine 50 so that it may illustrate. For example, on Ccurvilinear C1-1 with fixed energy, the effectiveness can be made the highest by operating an engine 50 on the operation point A1 (torque Te 1, rotational frequency Ne1). In curvilinear C2-C2 with the fixed energy Pe outputted, and C3-C3, the operation point with such highest effectiveness exists on each curve with fixed Energy Pe so that the operation point A2 and A3 may correspond, respectively. The curve A in drawing 11 is connected with the line which continues the operation point with which the effectiveness of an engine 50 becomes as high as possible to each energy Pe outputted from an engine 50 based on these. In the example, target torque Te* of an engine 50 and target engine-speed Ne* were set up using what used relation between each operation point on this curve A (Torque Te, engine speed Ne), and Energy Pe as the map.
[0088] Here, Curve A is connected with a continuous curve because the operational status of an engine 50 will change suddenly and it cannot shift to target operational status smoothly depending on extent of the change, but knocking may be produced or it may stop, when Energy Pe changes ranging over the discontinuous operation point if the operation point of an engine 50 is defined with a discontinuous curve to change of Energy Pe. Therefore, if Curve A is connected with a continuous curve in this way, each operation point on Curve A may not turn into the operation point with the highest effectiveness on a curve with fixed Energy Pe.
[0089] If target torque Te* of an engine 50 and target rotational frequency Ne* are set up, control CPU 90 compares set-up target rotational frequency Ne* with the rotational frequency Nd of a driving shaft 22 (step S172). Target rotational frequency Ne* and when larger than the rotational frequency Nd of a driving shaft 22 The 1st clutch 45 and the 2nd clutch 46 are operated so that the 1st clutch 45 may be off and the 2nd clutch 46 may serve as ON (configuration of the mimetic diagram of drawing 2 ) (step S174 thru/or S177). The torque computed by torque command value Tc* of a motor MG 1 by the top formula (1) based on target torque Te* of an engine 50 is set up (step S178). When it investigates whether actuation of the 1st clutch 45 and the 2nd clutch 46 is in the condition of detecting and setting up the condition of both the clutches 45 and 46, first (step S174) and is not in the condition of setting up, both the clutches 45 and 46 are both made off (step S176), and the 2nd clutch 46 is set to ON after that (step S177). Thus, both the clutches 45 and 46 are both [ once ] made off, because control of the motor MG2 grade at the time of clutch connection is easy. In addition, torque command value Tc* of a motor MG 1 will be set as load torque required in order to be stabilized and to operate an engine 50 on the operation point expressed with target torque Te* and target rotational frequency Ne*.
[0090] Target rotational frequency Ne* of an engine 50 at step S170 when smaller than the rotational frequency Nd of a driving shaft 22 By ON, the 1st clutch 45 operates the 1st clutch 45 and the 2nd clutch 46 so that the 2nd clutch 46 may serve as OFF (configuration of the mimetic diagram of drawing 3 ) (step S184 thru/or S187). The torque set up based on an upper type (1) after substituting for torque command value Td* which should be outputted to a driving shaft 22 at torque command value Tc* of a motor MG 1 is set up (step S188). Actuation of the 1st clutch 45 and the 2nd clutch 46 Target engine-speed Ne* detects the condition of both the clutches 45 and 46 first like the larger time than an engine speed Nd. When it investigates whether it is in the condition of setting up (step S184) and is not in the condition of setting up, both the clutches 45 and 46 are both made off (step S186), and the 1st clutch 45 is set to ON after that (step S187).
[0091] The reason for target rotational frequency Ne* of an engine 50 operating both the clutches 45 and 46 so that the power output unit 20 of an example may serve as undershirt drive association (refer to drawing 2 ), when larger than the rotational frequency Nd of a driving shaft 22, and operating both the clutches 45 and 46 here so that target rotational frequency Ne* may become overdrive association (refer to drawing 3 ), when smaller than a rotational frequency Nd is as follows. In undershirt drive association, circulation of power does not arise in the 1st operation mode which changes and outputs the power outputted from an engine 50 to power with a more low rotational frequency as already explained. Conversely, in overdrive association, circulation of power does not arise in the 2nd operation mode which changes and outputs the power outputted from an engine 50 to power with a more high rotational

frequency. Therefore, if in the undershirt drive with the engine speed Nd of a driving shaft 22 lower than target engine-speed Ne* of an engine 50 clutches 45 and 46 are operated so that undershirt drive association may be realized, and it operates it so that overdrive association may be realized in being reverse, operation effectiveness of the power output unit 20 can be made high. Actuation of the clutch mentioned above is based on this reason.

[0092] On the other hand, rotational frequency deflection **Ne is computed by subtracting a rotational frequency Ne from target rotational frequency Ne* of an engine 50 at step S156, when Energy Pd is the same as the last energy Pd (step S158). And Tc* is computed by the degree type (2) using computed rotational frequency deflection **Ne, and the computed value is set up as torque command value Tc* of a motor MG 1 (step S160). The 2nd term of the right-hand side in a formula (2) is a proportional which negates the deflection from target rotational frequency Ne* of a rotational frequency Ne here, and the 3rd term of the right-hand side is an integral term for abolishing steady-state deviation. Therefore, as for torque command value Tc* of a motor MG 1, the last torque command value Tc* will be set up by the steady state (when rotation deflection **Ne from target rotational frequency Ne* of a rotational frequency Ne is a value 0). In addition, Kc1 and Kc2 in a formula (2) are a proportionality constant. Thus, by setting up torque command value Tc* of a motor MG 1, an engine 50 can be stabilized on the operation point of target torque Te* and target rotational frequency Ne*.

[0093]

[Equation 1]

$$Tc^* \leftarrow \text{前回}Tc^* + Kc1\Delta Ne + Kc2\int \Delta Ne dt \quad \cdots\cdots(2)$$

[0094] Next, the torque outputted from a driving shaft 22 according to torque command value Tc* of a motor MG 1 is computed based on an upper type (1). And torque command value Ta* of a motor MG 2 is set up so that demand torque may be outputted from a driving shaft (step S164).

[0095] In this way, a setup of torque command value Tc* of target torque Te* of an engine 50, target rotational frequency Ne*, a motor MG 1, and a motor MG 2 and Ta* performs control of a motor MG 1, a motor MG 2, and an engine 50 so that a motor MG 1, a motor MG 2, and an engine 50 may operate with each set-up set point (step S166 thru/or S169). although the example indicated each control of a motor MG 1, a motor MG 2, and an engine 50 as a separate step of this routine on account of illustration, these control is separate from this routine in fact -- it is carried out independently and synthetically. For example, while control CPU 90 is parallel control of a motor MG 1 and a motor MG 2 and performs [ control ] to different timing from this routine using interruption processing, it is made to carry out by transmitting directions to EFIECU70 by communication link, and control of an engine 50 being parallel with EFIECU70.

[0096] Control (step S162 of drawing 9 ) of a motor MG 1 is made by the clutch motor control routine illustrated to drawing 13 . If this routine is performed, the control CPU 90 of a control device 80 will perform first processing which inputs angle-of-rotation thetad of the revolving shaft of Rota 31 from a resolver (step S190), and will perform processing which asks for electrical angle thetac of a motor MG 1 from angle-of-rotation thetad of both shafts (step S194). In the example, since the synchronous motor of four pole pairs is used as a motor MG 1, thetac=4thetad will be calculated.

[0097] Next, processing which detects the currents Iuc and Ivc which are flowing to U phase and V phase of a three phase coil of a motor MG 1 with the current detectors 95 and 96 is performed (step S196). Although the current is flowing to the three phase of U, V, and W, since the total is zero, it is sufficient if the current which flows to two phases is measured. In this way, coordinate transformation (a three phase circuit/2 phase-number conversion) is performed using the current of the obtained three phase (step S198). Coordinate transformation is changing into the current value of d shaft of the synchronous motor of a permanent-magnet type, and q shaft, and is performed by calculating a degree type (3). Coordinate transformation is performed in the synchronous motor of a permanent-magnet type here because it is an amount with the current of d shaft and q shaft essential when controlling torque. It is also possible to control from the first with a three phase.

[0098]
[Equation 2]

$$\begin{bmatrix} Idc \\ Iqc \end{bmatrix} = \sqrt{2} \begin{bmatrix} -\sin(\theta c - 120) & \sin\theta c \\ -\cos(\theta c - 120) & \cos\theta c \end{bmatrix} \begin{bmatrix} Iuc \\ Ivc \end{bmatrix} \qquad \cdots\cdots(3)$$

[0099] Next, after changing into a biaxial current value, processing which asks for current command value Idc* of each shaft searched for from torque command value Tc* in a motor MG 1, Iqc*, the currents Idc and Iqc that actually flowed on each shaft, and deflection, and calculates the electrical-potential-difference command values Vdc and Vqc of each shaft is performed (step S200). That is, the following formulas (4) are calculated first and then a degree type (5) is calculated. Here, Kp 1 and 2 and Ki 1 and 2 are multipliers respectively. These multipliers are adjusted so that the property of the motor to apply may be suited. In addition, the electrical-potential-difference command values Vdc and Vqc are calculated from the part (the 1st term of the formula (5) right-hand side) proportional to deflection **I with current command value I*, and an accumulated part (the 2nd term of the right-hand side) of the past of i batch of deflection **I.
[0100]
[Equation 3]

$$\Delta Idc = Idc^* - Idc$$
$$\Delta Iqc = Iqc^* - Iqc \qquad \cdots\cdots(4)$$

[0101]
[Equation 4]

$$Vdc = Kp1 \cdot \Delta Idc + \sum Ki1 \cdot \Delta Idc$$
$$Vqc = Kp2 \cdot \Delta Iqc + \sum Ki2 \cdot \Delta Iqc \qquad \cdots\cdots(5)$$

[0102] Then, coordinate transformation (2 phases / three-phase-circuit conversion) equivalent to the inverse transformation of the conversion which performed the electrical-potential-difference command value calculated in this way at step S198 is performed (step S202), and processing which asks for the electrical potential differences Vuc, Vvc, and Vwc actually impressed to a three phase coil is performed. It asks for each electrical potential difference by the degree type (6).
[0103]
[Equation 5]

$$\begin{bmatrix} Vuc \\ Vvc \end{bmatrix} = \sqrt{\frac{2}{3}} \begin{bmatrix} \cos\theta c & -\sin\theta c \\ \cos(\theta c - 120) & -\sin(\theta c - 120) \end{bmatrix} \begin{bmatrix} Vdc \\ Vqc \end{bmatrix}$$
$$Vwc = -Vuc - Vvc \qquad \cdots\cdots(6)$$

[0104] Since actual armature-voltage control is made by the on-off time amount of the transistor of the 1st drive circuit 91, it carries out PWM control of the ON time amount of each transistor so that it may become each electrical-potential-difference command value calculated by the formula (6) (step S204). Control (step S168 of drawing 9 ) of a motor MG 2 is also the same processing.
[0105] Next, control (step S169 of drawing 9 ) of an engine 50 is explained. Torque Te and a rotational frequency Ne are controlled so that an engine 50 will be in a steady operation condition on the operation point of target torque Te* set up in step S170 of drawing 10 , and target rotational frequency Ne*. Specifically so that an engine 50 may be operated on the operation point of target torque Te* and target rotational frequency Ne* While EFIECU70 which received target torque Te* and target engine-speed Ne* by communication link from control CPU 90 performs opening control of a throttle valve, fuel-injection control from a fuel injection valve 51, and ignition control by the ignition plug 62 The torque Tc of the motor MG 1 as load torque of an engine 50 is controlled by the control CPU 90 of a control device 80. It is because control of the torque Tc of the motor MG 1 which cannot operate an engine 50

only by control by EFIECU70 on the operation point of target torque Te* and target rotational frequency Ne* since output-torque Te and a rotational frequency Ne change with the load torque, but gives load torque is also needed. In addition, control of the motor MG 1 mentioned above explained control of the torque Tc of a motor MG 1.

[0106] the thing which were explained above and which is usually considered as undershirt drive association (configuration of the mimetic diagram of drawing 2 ) according to operation torque control processing when the engine speed Ne of an engine 50 is larger than the engine speed Nd of a driving shaft 22 -- circulation of power -- decreasing -- the power output unit 20 -- energy efficiency can be made high as a whole. moreover, the thing considered as overdrive association (configuration of the mimetic diagram of drawing 3 ) when the engine speed Ne of an engine 50 is smaller than the engine speed Nd of a driving shaft 22 -- too -- circulation of power -- decreasing -- the power output unit 20 -- energy efficiency can be made high as a whole. Therefore, as compared with the case where it fixes to the configuration of the mimetic diagram of drawing 2 or drawing 3 , energy efficiency can be made high.

[0107] Moreover, since it will be set up so that an engine 50 may serve as the highest possible effectiveness if the energy Pe which is outputted from an engine 50 in target torque Te* of an engine 50 and target engine-speed Ne* according to operation torque control processing is usually the same, energy efficiency as the power output unit 20 whole can be made higher. Moreover, if the effectiveness Ksc and Ksa of a motor MG 1 and a motor MG 2 is considered to be a value 1, torque conversion can be carried out and the power with which it is expressed by target torque Te* and target rotational frequency Ne* which are outputted from an engine 50 can be outputted to the power with which it is expressed by a motor MG 1 and the motor MG 2 at torque command value Td* and a rotational frequency Nd at a driving shaft 22. And since target torque Te* of an engine 50 and target rotational frequency Ne* are defined based on this torque command value Td* according to the amount of treading in of the accelerator pedal 64 by the operator, the torque (torque command value Td*) which should be outputted to a driving shaft 22 can output the power of a request of an operator to a driving shaft 22.

[0108] (3) Explain charge-and-discharge torque control processing, next charge-and-discharge torque control processing (step S114 of drawing 5 ) based on drawing 14 and the charge-and-discharge torque control routine of drawing 15 . As mentioned above, it is out of range, and charge-and-discharge mode is set up and this routine is performed, when [ at which the remaining capacity BRM of a dc-battery 94 is expressed with steps S130 and S132 of drawing 7 with a threshold BL and a threshold BH ] it is judged that the charge and discharge of a dc-battery 94 are required.

[0109] If this routine is performed, control CPU 90 measures the remaining capacity BRM of a dc-battery 94 with a threshold BL and a threshold BH first (step S220). Step S130 of drawing 7 explained the threshold BL and the threshold BH. When the remaining capacity BRM of a dc-battery 94 is under the threshold BL Judge that a dc-battery 94 needs to be charged and processing (step S222 thru/or S228) which sets up the energy Pd in consideration of energy (charge energy Pbi) required to charge a dc-battery 94 is performed. When the remaining capacity BRM of a dc-battery 94 is larger than a threshold BH, it judges that a dc-battery 94 needs to be discharged, and processing (step S232 thru/or S238) which sets up the energy Pd in consideration of the energy (charge energy Pbo) which discharges from a dc-battery 94 is performed.

[0110] In the processing (step S222 thru/or 228) which sets up the energy Pd in consideration of the charge energy Pbi required to charge a dc-battery 94, the control CPU 90 of a control device 80 performs first processing which sets up the charge energy Pbi based on the remaining capacity BRM of a dc-battery 94 (step S222). Thus, it is because the power (energy) which setting up the charge energy Pbi based on the remaining capacity BRM of a dc-battery 94 can charge [ of a dc-battery 94 ] changes with remaining capacity BRM and also changes a proper charge electrical potential difference and the proper charging current by remaining capacity BRM. An example of the relation between the remaining capacity BRM of a dc-battery 94 and the power which can be charged is shown in drawing 16 . In addition, in the example, the optimal charge energy Pbi shall be searched for by experiment etc. from each remaining capacity BRM of a dc-battery 94, it shall be beforehand memorized as a map to ROM,

and the charge energy Pbi corresponding to the remaining capacity BRM of a dc-battery 94 shall be derived. Then, the charge energy Pbi drawn to the energy Pd which should be outputted to a driving shaft 22 is added, and Energy Pd is reset (step S224). And it investigates whether the energy Pd which it reset is over the maximum energy Pemax in which an output is possible from the engine 50 (step S226), and when having exceeded, maximum energy Pemax is set as Energy Pd as processing which restricts Energy Pd to maximum energy Pemax (step S228).

[0111] In the processing (step S232 thru/or S238) which sets up the energy Pd in consideration of energy (charge energy Pbo) required to discharge a dc-battery 94, the control CPU 90 of a control device 80 performs first processing which sets up spark discharge energy Pbo based on the remaining capacity BRM of a dc-battery 94 (step S232). Thus, based on the remaining capacity BRM of a dc-battery 94, spark discharge energy Pbo is set up because the power (energy) which can discharge a dc-battery 94 may change with remaining capacity BRM. In the example, the optimal discharge energy Pbo shall be searched for by experiment etc. from each remaining capacity BRM of the used dc-battery 94, it shall be beforehand memorized as a map (not shown) to ROM, and the spark discharge energy Pbo corresponding to the remaining capacity BRM of a dc-battery 94 shall be derived. Then, the spark discharge energy Pbo drawn from the energy Pd which should be outputted to a driving shaft 22 is reduced, and Energy Pd is reset (step S234). And the energy Pd which it reset investigates whether it is under threshold energy Pemin in which an output is possible from an engine 50 (step S236), and sets threshold energy Pemin as Energy Pd as processing which restricts Energy Pd to threshold energy Pemin at the case of under threshold energy Pemin (step S218).

[0112] Thus, resetting of the energy Pd which should be outputted to a driving shaft 22 in consideration of the charge energy Pbi or spark discharge energy Pbo sets up target torque Te* of an engine 50, and target rotational frequency Ne* based on this energy Pd that it reset (step S240). Setting processing of this target torque Te* and target rotational frequency Ne* is the same as processing of step S170 of drawing 10 .

[0113] Next, processing which reads the engine speed Nd of a driving shaft 22 is performed (step S242), and target engine-speed Ne* of the set-up engine 50 is compared with the engine speed Nd of the read driving shaft 22 (step S244). And the 1st clutch 45 and the 2nd clutch 46 are operated so that the 1st clutch 45 has off target engine-speed Ne* of an engine 50 when larger than the engine speed Nd of a driving shaft 22, and the 2nd clutch 46 may serve as ON (configuration of the mimetic diagram of drawing 2 ) (step S250 thru/or S254). The processing (step S250 thru/or processing of S254) which operates the 1st clutch 45 and the 2nd clutch 46 so that it may become the configuration of the mimetic diagram of drawing 2 about the power output unit 20 of an example is the same as the step [ in / including the reason for both / once / making both the clutches 45 and 46 off / drawing 9 and the usual operation torque control routine of drawing 10 ] S174 thru/or processing of S177, when it will be in the condition that both the clutches 45 and 46 are going to set up.

[0114] On the other hand, by ON, when smaller than the engine speed Nd of a driving shaft 22, the 1st clutch 45 operates [ target engine-speed Ne* which is an engine 50 / the 2nd clutch 46 ] the 1st clutch 45 and the 2nd clutch 46 so that OFF (configuration of the mimetic diagram of drawing 3 ) may come (step S260 thru/or S264). In addition, the processing (step S250 thru/or processing of S254) which operates the 1st clutch 45 and the 2nd clutch 46 so that it may become the configuration of the mimetic diagram of drawing 3 about the power output unit 20 of an example When it will be in the condition that both the clutches 45 and 46 are going to set up, it is the same as that of the step [ in / including the reason for both / once / making both the clutches 45 and 46 off / drawing 9 and the usual operation torque control routine of drawing 10 ] S184 thru/or processing of S187.

[0115] After connecting a clutch, torque command value Tc* of a motor MG 1 is set up so that target torque Te* of an engine 50 may be realized (step S266), and torque command value Ta* of a motor MG 2 is set up so that torque command value Td* which should be outputted to a driving shaft 22 may be attained (step S268). These values are computed based on an upper type (1).

[0116] Thus, if torque command value Tc* of a motor MG 1 and torque command value Ta* of a motor MG 2 are set up while operating both the clutches 45 and 46 according to the engine speed Nd of target

engine-speed Ne* of an engine 50, and a driving shaft 22, each control of a motor MG 1, a motor MG 2, and an engine 50 will be performed using these set-up set points (step S270 thru/or S274). Since these the control of each is the same as each control of step S166 thru/or S169 in drawing 9 and the usual operation torque control routine of drawing 10 , explanation here is omitted. In addition, although each control of such a motor MG 1, a motor MG 2, and an engine 50 is performed also in each routine of other torque control processings, since it is the same as that of each control of step S166 thru/or S169 in drawing 9 and the usual operation torque control routine of drawing 10 unless it indicates especially, the explanation is omitted.

[0117] Next, signs that it discharges from signs that a dc-battery 94 is charged by such charge-and-discharge torque control processing, and a dc-battery 94 are explained. At step S220, when the remaining capacity BRM of a dc-battery 94 is smaller than a threshold BL, the charge energy Pbi is added to Energy Pd, it resets Energy Pd, and target torque Te* of an engine 50 and target rotational frequency Ne* are set up based on this energy Pd that it reset. On the other hand, irrespective of target rotational frequency Ne* of an engine 50, and the rotational frequency Nd of a driving shaft 22, torque command value Tc* of a motor MG 1 and torque command value Ta* of a motor MG 2 are set up so that torque command value Td* may be outputted to a driving shaft 22. For this reason, the energy Pe outputted from an engine 50 becomes larger than the energy Pd outputted to a driving shaft 22. consequently, at the time of the configuration of target rotational frequency Ne* of an engine 50 of the mimetic diagram of drawing 2 smaller than the rotational frequency Nd of a driving shaft 22 The power revived by the motor MG 1 becomes larger than the power consumed by the motor MG 2. The power revived by the motor MG 2 becomes larger than the power consumed by the motor MG 1, and dump power will arise also in the time of the configuration of which mimetic diagram at the time of the configuration of target rotational frequency Ne* of an engine 50 of the mimetic diagram of bigger drawing 3 than the rotational frequency Nd of a driving shaft 22. In the example, a dc-battery 94 is charged by this dump power.

[0118] On the other hand, at step S220, when the remaining capacity BRM of a dc-battery 94 is bigger than a threshold BL, spark discharge energy Pbo is subtracted from Energy Pd, it resets Energy Pd, and target torque Te* of an engine 50 and target rotational frequency Ne* are set up based on this energy Pd that it reset. On the other hand, irrespective of target rotational frequency Ne* of an engine 50, and the rotational frequency Nd of a driving shaft 22, torque command value Tc* of a motor MG 1 and torque command value Ta* of a motor MG 2 are set up so that torque command value Td* may be outputted to a driving shaft 22. For this reason, the energy Pe outputted from an engine 50 becomes smaller than the energy Pd outputted to a driving shaft 22. consequently, at the time of the configuration of target rotational frequency Ne* of an engine 50 of the mimetic diagram of drawing 2 smaller than the rotational frequency Nd of a driving shaft 22 The power revived by the motor MG 1 becomes smaller than the power consumed by the motor MG 2. At the time of the configuration of target rotational frequency Ne* of an engine 50 of the mimetic diagram of bigger drawing 3 than the rotational frequency Nd of a driving shaft 22, the power revived by the motor MG 2 becomes smaller than the power consumed by the motor MG 1, and power will be insufficient also in the time of the configuration of which mimetic diagram. This insufficient power is provided with the discharge from a dc-battery 94 in the example.

[0119] According to charge-and-discharge torque control processing in which it explained above, remaining capacity BRM of a dc-battery 94 can be made into the range of desired. Consequently, the overdischarge and overcharge of a dc-battery 94 are avoidable. And energy conversion of the power by which charge and discharge are carried out to the energy Pe outputted from an engine 50 with a dc-battery 94 can be carried out, and it can output to a driving shaft 22 as desired power. By operating the 1st clutch 45 and the 2nd clutch 46 based on the engine speed Ne of an engine 50, and the engine speed Nd of a driving shaft 22, and considering as the configuration of the mimetic diagram of drawing 2 , or the configuration of the mimetic diagram of drawing 3 from the first, the energy loss by the motor MG 1 and the motor MG 2 can be made small, and energy efficiency can be made high as the whole equipment. Moreover, if the operation point of an engine 50 is the operation point which outputs the set-

up energy Pd, since it is good as any operation points, it can operate an engine 50 on the more efficient operation point. Consequently, energy efficiency of the whole equipment can be made higher.
[0120] In addition, although the charge energy Pbi and spark discharge energy Pbo were set up in the power output unit 20 of an example based on the remaining capacity BRM of a dc-battery 94, it is good also as a predetermined value which defined beforehand the charge energy Pbi and spark discharge energy Pbo.
[0121] (4) Explain power assistant torque control processing, next power assistant torque control processing (step S116 of drawing 5 ) based on the power assistant torque control routine of drawing 17 . This routine is performed when the energy Pd which should be outputted to a driving shaft 22 at steps S134 and S136 of drawing 7 is over the maximum energy Pemax in which an output is possible from the engine 50.
[0122] If this routine is performed, the control CPU 90 of a control device 80 will perform processing which sets up target torque Te* of an engine 50, and target rotational frequency Ne* first based on the maximum energy Pemax in which an output is possible from an engine 50 (step S280). Thus, since the energy Pd which should be outputted to a driving shaft 22 at step S134 of the operation mode judging manipulation routine of drawing 7 serves as a bigger value than maximum energy Pemax, energy Pe outputted from an engine 50 is set to maximum energy Pemax for providing as much energy of the energy Pd which should be outputted to a driving shaft 22 as possible with the energy outputted from an engine 50.
[0123] Then, the maximum energy Pemax in which an engine 50 to an output is possible is subtracted from the energy Pd which should be outputted to a driving shaft 22, and the energy running short is computed as assistant power Pas with the energy Pe outputted from an engine 50 (step S282). Then, based on the remaining capacity BRM of a dc-battery 94, the maximum discharge energy Pbmax which is the maximum of the energy which can discharge from a dc-battery 94 is drawn (step S284), and it judges whether it is larger than the maximum discharge energy Pbmax which the computed assistant power Pas drew (step S286). Here, the maximum discharge energy Pbmax is set up based on the remaining capacity BRM of a dc-battery 94 because the power (energy) which can discharge a dc-battery 94 may change with remaining capacity BRM. In the example, the maximum discharge energy Pbmax shall be searched for by experiment etc. from each remaining capacity BRM of the used dc-battery 94, it shall be beforehand memorized as a map (not shown) to ROM, and the maximum discharge energy Pbmax corresponding to the remaining capacity BRM of a dc-battery 94 shall be derived. When the assistant power Pas is larger than the maximum discharge energy Pbmax, the maximum discharge energy Pbmax is set as the assistant power Pas (step S288), and it is made for the assistant power Pas not to become larger than the maximum discharge energy Pbmax.
[0124] Next, processing which reads the engine speed Nd of a driving shaft 22 is performed (step S290), and target engine-speed Ne* of an engine 50 is compared with the engine speed Nd of a driving shaft 22 (step S292). And the 1st clutch 45 and the 2nd clutch 46 are operated so that the 1st clutch 45 has off target engine-speed Ne* of an engine 50 when larger than the engine speed Nd of a driving shaft 22, and the 2nd clutch 46 may serve as ON (configuration of the mimetic diagram of drawing 2 ) (step S294 thru/or S298). This processing is the same as the processing (step S174 thru/or processing of S177 and step S184 thru/or processing of S187) which operates the 1st clutch 45 and the 2nd clutch 46 in a usual operation torque control routine of already explained drawing 9 and drawing 10 .
[0125] When smaller than the engine speed Nd of a driving shaft 22, the 1st clutch 45 operates [ target engine-speed Ne* of an engine 50 / the 2nd clutch 46 ] the 1st clutch 45 and the 2nd clutch 46 by ON so that OFF (configuration of the mimetic diagram of drawing 3 ) may come (step S304 thru/or S308). It is the same as that of the processing (step S174 thru/or processing of S177 and step S184 thru/or processing of S187) which operates the 1st clutch 45 and the 2nd clutch 46 in a usual operation torque control routine of drawing 9 and drawing 10 .
[0126] After connecting a clutch, torque command value Tc* of a motor MG 1 is set up so that target torque Te* of an engine 50 may be realized (step S266), and torque command value Ta* of a motor MG 2 is set up so that torque command value Td* which should be outputted to a driving shaft 22 may be

attained (step S268). These values are computed based on an upper type (1).
[0127] In this way, if torque command value Tc* of a motor MG 1 and torque command value Ta* of a motor MG 2 are set up while operating both the clutches 45 and 46 according to the engine speed Nd of target engine-speed Ne* of an engine 50, and a driving shaft 22, each control of a motor MG 1, a motor MG 2, and an engine 50 will be performed using these set-up set points (step S314 thru/or S318).
[0128] According to power assistant torque control processing in which it explained above, the energy more than maximum energy Pemax of an engine 50 can be outputted to a driving shaft 22. Consequently, the low engine of the rated capacity which makes maximum energy energy smaller than the energy Pd which should be outputted to a driving shaft 22 can also be adopted as the power output unit 20, and a miniaturization and energy saving of the whole equipment can be attained. By operating the 1st clutch 45 and the 2nd clutch 46 based on the engine speed Ne of an engine 50, and the engine speed Nd of a driving shaft 22, and considering as the configuration of the mimetic diagram of drawing 2 , or the configuration of the mimetic diagram of drawing 3 from the first, the energy loss by the motor MG 1 and the motor MG 2 can be made small, and energy efficiency can be made high as the whole equipment. Moreover, if the operation point of an engine 50 is the operation point which outputs the set-up energy Pd, since it is good as any operation points, it can operate an engine 50 on the more efficient operation point. Consequently, energy efficiency of the whole equipment can be made higher.
[0129] (5) Explain direct-output torque control processing, next direct-output torque control processing (step S118 of drawing 5 ) based on the direct-output torque control routine of drawing 19 . This routine is performed when the rotational frequency Nd of torque command value Td* in step S138 of drawing 7 and a driving shaft 22 is in the range in which an output is possible without the change in the torque by the motor MG 2 when an engine 50 is operated in the range (the field PA of drawing 8 ) which can be operated efficiently. If this routine is performed, the control CPU 90 of a control unit 80 will perform first processing which reads the rotational frequency Nd of a driving shaft 22 (step S320). Next, target torque Te* of an engine 50 and target rotational frequency Ne* are set up, respectively (step S322). As target rotational frequency Ne*, the rotational frequency Nd of a driving shaft 22 is set up. Moreover, as target torque Te*, torque command value Td* of a driving shaft 22 is set up.
[0130] Then, when [ both ] it investigates whether both the 1st clutch 45 and the 2nd clutch 46 serve as ON (step S324) and neither of both clutches 45 and 46 serve as ON, both the clutches 45 and 46 are set to ON (step S326). Thus, by operating the 1st clutch 45 and the 2nd clutch 46, the power output unit 20 serves as a configuration which coupled directly the crankshaft 56 and the driving shaft 22. Planetary gear 200 stop consequently, doing the distribution frame of power so.
[0131] Next, a value 0 is set as both torque command value Tc* of a motor MG 1, and torque command value Ta* of a motor MG 2 (steps S328 and S330), and each control of a motor MG 1, a motor MG 2, and an engine 50 is performed (step S332 thru/or S336). Here, as control of the motors MG1 and MG2 when a value 0 is set as torque command value Ta*, although the motor control routine of drawing 13 can perform, since what is necessary is just to make all the currents of each phase of motors MG1 and MG2 into a value 0, in the example, all the transistors of the drive circuits 91 and 92 are set to OFF.
[0132] According to direct-output torque control processing in which it explained above, it can output to the direct-drive shaft 22 by setting both the 1st clutch 45 and the 2nd clutch 46 to ON, without carrying out torque conversion of the power outputted from an engine 50. Therefore, the energy loss by the motor MG 1 and the motor MG 2 can be made into zero. And since this direct-output torque control processing is performed when there is an engine speed Nd of the torque (torque command value Td*) which should be outputted to a driving shaft 22, and a driving shaft 22 within limits which can operate an engine 50 efficiently, it can output power to a driving shaft 22 more efficiently.
[0133] In addition, although considered as the same actuation as the configuration which sets a value 0 as torque command value Tc* of a motor MG 1, and torque command value Ta* of a motor MG 2, and a motor MG 1 and a motor MG 2 do not have in both the power output units 20 of an example It is good also as what outputs power to a driving shaft 22 from a motor MG 2, or revives power from a driving shaft 22 by the motor MG 2 using the electrical energy which discharges from a dc-battery 94, and charges a dc-battery 94. It can perform, if the engine speed Nd of a driving shaft 22 is in the range which

can operate an engine 50 efficiently, without being restricted at the time that the torque (torque command value Td*) which should output direct-output torque control processing to a driving shaft 22, and the engine speed Nd of a driving shaft 22 are in the range (the field PA of drawing 8 ) which can operate an engine 50 efficiently if it carries out like this. Hereafter, such direct-output torque control processing is briefly explained based on the direct-output torque control routine of drawing 20 .
[0134] When the direct-output torque control routine of drawing 20 is performed, the control CPU 90 of a control unit 80 First, read the rotational frequency Nd of a driving shaft 22 (step S340), and the rotational frequency Nd of the read driving shaft 22 is set as target rotational frequency Ne* of an engine 50 (step S342). It investigates whether both the 1st clutch 45 and the 2nd clutch 46 are ON (step S344), and when [ both ] neither of both clutches 45 and 46 are ON, both the clutches 45 and 46 are set to ON (step S346). Next, processing which reads the pull up torque T1 and the maximum torque T2 in the range (the field PA of drawing 8 ) which can operate efficiently the engine 50 in the engine speed Nd of a driving shaft 22 is performed (step S348), and it compares with the pull up torque T1 and the maximum torque T2 which read torque command value Td* (step S350). In addition, in the example, reading of pull up torque T1 and the maximum torque T2 memorizes beforehand the engine 50 to each engine speed Nd of a driving shaft 22 to ROM in quest of the pull up torque T1 and the maximum torque T2 of the range which can be operated efficiently by experiment etc., and if the engine speed Nd of a driving shaft 22 is read, it shall derive pull up torque T1 and the maximum torque T2 from this engine speed Nd and map.
[0135] If torque command value Td* is less than [ maximum torque T2 ] more than in pull-up-torque T1 Torque command value Td* is set as target torque Te* of an engine 50 (step S354). When torque command value Td* is less than [ pull-up-torque T1 ], pull up torque T1 is set as target torque Te* (step S352), and torque command value Td* sets the maximum torque T2 as target torque Te*, when larger than the maximum torque T2 (step S356). Thus, by setting up, the operation point of target torque Te* of an engine 50 and target engine-speed Ne* becomes in the range (the field PA of drawing 8 ) which can operate efficiently the engine 50 mentioned above.
[0136] Then, while setting a value 0 as torque command value Tc* of a motor MG 1 (step S358), what subtracted target torque Te* of an engine 50 from torque command value Td* is set as torque command value Ta* of a motor MG 2 (step S360). In this way, a setup of target torque Te* of an engine 50, target rotational frequency Ne*, torque command value Tc* of a motor MG 1, and torque command value Ta* of a motor MG 2 performs each control (step S362 thru/or S366) of a motor MG 1, a motor MG 2, and an engine 50 using these set points.
[0137] Drawing 21 is an explanatory view which illustrates signs that power is outputted to the driving shaft 22 at the time of performing the direct-output torque control routine of such drawing 20 . When torque command value Td* which the driving shaft 22 is rotating at the rotational frequency Nd1, and becomes settled now according to the amount of treading in of an accelerator pedal 64 is a value Td1, the time of wanting to operate a driving shaft 22 on the operation point Pd 1 is considered. Although an engine speed Nd1 is in the range PA which can operate an engine 50 efficiently, torque command value Td* is in the condition far exceeding the upper limit of this range PA. At this time, the torque (value Te 1) of the upper limit of the range PA in a rotational frequency Nd1 is set as target torque Te* of an engine 50 as the maximum torque T2 (step S356). Since an engine speed Nd1 is set as target engine-speed Ne* of an engine 50 as it is (step S342), an engine 50 will be operated on the operation point Pe1 with which it is expressed at torque Te 1 and an engine speed Nd1. Since torque command value Ta* of a motor MG 2 is called for as torque (value Ta 1) which subtracted target torque Te* (value Te 1) of an engine 50 from torque command value Td* (value Td1) (step S360) The energy given to a driving shaft 22 By setting both the 1st clutch 45 and the 2nd clutch 46 to ON It becomes the energy (Td1xNd1) which added the energy (Ta1xNd1) outputted to the direct-drive shaft 22 from a motor MG 2 at the energy (Te1xNd1) outputted to the direct-drive shaft 22 from an engine 50. In addition, the energy outputted to a driving shaft 22 from a motor MG 2 is provided by the power which discharges from a dc-battery 94.
[0138] Next, the time of the driving shaft 22 rotating at the rotational frequency Nd2, and wanting to

operate a driving shaft 22 on the operation point Pd 2 in drawing 21 , when output-torque command value Td* is a value Td2 is considered. Although an engine speed Nd2 is in the range PA which can operate an engine 50 efficiently, torque command value Td* is in the condition which is less than the minimum of this range PA. At this time, the torque (value Te 2) of the lower limit of the range PA in a rotational frequency Nd2 is set as target torque Te* of an engine 50 as pull up torque T1 (step S352). Since an engine speed Nd2 is set as target engine-speed Ne* of an engine 50 as it is (step S342), an engine 50 will be operated on the operation point Pe2 expressed with torque Te 2 and an engine speed Nd2. Since torque command value Ta* of a motor MG 2 is called for as torque (the negative value Ta 2) which subtracted target torque Te* of an engine 50 from torque command value Td* (step S360) The energy given to a driving shaft 22 By setting both the 1st clutch 45 and the 2nd clutch 46 to ON It becomes the energy (Td2xNd2) which subtracted the energy (Ta2xNd2) equivalent to the power revived by the motor MG 2 from the energy (Te2xNd2) outputted to the direct-drive shaft 22 from an engine 50. In addition, the power revived by the motor MG 2 is used for charge of a dc-battery 94.

[0139] If the rotational frequency Nd of a driving shaft 22 is within the limits of this even if there is no torque (torque command value Td*) which should be outputted to a driving shaft 22 if the direct-output torque control routine of the modification shown in drawing 20 with the power output unit 20 of an example is performed as explained above into the range (the field PA of drawing 8 ) which can operate an engine 50 efficiently, direct-output torque control processing can be performed. And since a motor MG 2 is driven by the charge and discharge of a dc-battery 94 with the torque of the deflection of target torque Te* of an engine 50, and torque command value Td*, desired torque can be made to act on a driving shaft 22.

[0140] (6) Explain motor driving torque control processing, next motor driving torque control processing (step S120 of drawing 5 ) based on the motor driving torque control routine of drawing 22 . This routine is performed when the energy Pd which should be outputted to a driving shaft 22 at steps S142 and S144 of drawing 7 is judged that the rotational frequency Nd of a driving shaft 22 is smaller than the predetermined rotational frequency NML smaller than the predetermined energy PML.

[0141] When this routine is performed, the control CPU 90 of a control unit 80 First, it investigates whether the stop instruction of operation of an engine 50 is outputted (step S370). The signal which suspends operation of an engine 50 when the stop instruction of operation of an engine 50 is outputted is transmitted to EFIECU70 (step S372). When the stop instruction of operation of an engine 50 is not outputted, the signal which makes an engine 50 idle operational status is transmitted to EFIECU70 (step S374). The stop instruction of operation of an engine 50 here may be outputted to setting to ON the switch which directs a halt of the case where it is outputted from EFIECU70 according to the condition of the catalyst equipment which was formed in the operational status of an engine 50 or the exhaust pipe of an engine 50, and which is not illustrated etc., and the engine 50 which an operator does not illustrate. In addition, although control of an engine 50 was expressed with drawing 22 as step S390 on account of illustration Since it is carried out separately [ control of an engine 50 ] from such a torque control routine independently as mentioned above, When the signal with which the control CPU 90 of a control device 80 suspends operation of an engine 50 to EFIECU70, and the signal which makes an engine 50 idle operational status are transmitted, EFIECU70 Control of an engine 50 is started so that it may be in a halt or idle operational status about an engine 50 immediately. Control of an engine 50 turns into control which stops impression of the electrical potential difference to an ignition plug 62 while suspending the fuel injection from a fuel injection valve 51, when the stop instruction of operation of an engine 50 is outputted. When making an engine 50 into idle operational status It becomes the control of the opening of an idle speed control valve and the control of fuel oil consumption which were prepared in the communicating tube for idle control which bypasses a throttle valve so that an engine 50 may be operated with idle rpm after making a throttle valve into a close by-pass bulb completely, and which is not illustrated and which are not illustrated.

[0142] Next, the 1st clutch 45 is off and it investigates whether the 2nd clutch 46 serves as ON (configuration of the mimetic diagram of drawing 2 ) (step S376), and when [ both ] it will be in the condition that both the clutches 45 and 46 tend to set up, the 2nd clutch 46 is once set to ON after that

by setting both the clutches 45 and 46 to OFF (step S378) (step S380). And torque command value Td* which is the torque which should be outputted to a driving shaft 22 is set as torque command value Ta* of a motor MG 2 (step S382), the value which is equivalent to the reaction force torque at torque command value Tc* of a motor MG 1 is set up (step S384), and each control of a motor MG 1, a motor MG 2, and an engine 50 is performed (step S386 thru/or S390).

[0143] According to motor driving torque control processing in which it explained above, a car can be driven only under the power outputted from a motor MG 2 by setting the 1st clutch 45 to OFF, considering the power output unit 20 as the configuration of the mimetic diagram of drawing 2 by setting the 2nd clutch 46 to ON, and supporting the reaction force torque of a motor MG 2 by the motor MG 1 further. And such motor driving torque control processing is performed when the energy Pd which should be outputted to a driving shaft 22 serves as the low operation point of the effectiveness of an engine 50, and since operation of an engine 50 is suspended or an engine 50 is made into idle operational status, decline in the energy efficiency by operating an engine 50 on the low operation point of effectiveness is avoidable.

[0144] Although the 1st clutch 45 shall be set to OFF, the power output unit 20 shall be considered as the configuration of the mimetic diagram of drawing 2 by setting the 2nd clutch 46 to ON and power shall be outputted to a driving shaft 22 from a motor MG 2 in motor driving torque control processing of an example It is good also as what sets the 1st clutch 45 to ON, considers the power output unit 20 as the configuration of the mimetic diagram of drawing 3 by setting the 2nd clutch 46 to OFF, and outputs power to a driving shaft 22 by the motor MG 1 and the motor MG 2. Such motor driving torque control processing is made by the motor driving torque control routine of the modification illustrated to drawing 23 . Hereafter, motor driving torque control processing of this modification is explained briefly.

[0145] After transmitting the signal which suspends operation of an engine 50, or the signal which makes an engine 50 idle operational status to EFIECU70 by the routine of this modification, (Step S400 thru/or S404), The 1st clutch 45 investigates whether the 2nd clutch 46 serves as OFF (configuration of the mimetic diagram of drawing 3 ) by ON (step S406). When it will be in the condition that both the clutches 45 and 46 tend to set up, the 1st clutch 45 is set to ON after that, both [ once ] using both the clutches 45 and 46 as off (step S408) (step S410). And torque command value Tc* (step S412) of a motor MG 1 and torque command value Ta* of a motor MG 2 are set up. Both value is set up based on a top type (1) so that desired torque may be outputted from a driving shaft 22. In this way, according to the set-up torque command value, each control of a motor MG 1, a motor MG 2, and an engine 50 is performed (step S416 thru/or S419). Thus, the torque equivalent to torque command value Td* can be outputted to a driving shaft 22 from a motor MG 1 by setting up torque command value Tc* and Ta*. In addition, when an engine 50 is in the condition of shutdown, it is good also as what carries out the lock-up of the motor MG 2. Moreover, when making an engine 50 into idle operational status, it is good also as what carries out feedback control of torque command value Ta* of a motor MG 2 so that the engine speed Ne of a crankshaft 56 may turn into idle rpm.

[0146] Moreover, although the 1st clutch 45 shall be set to OFF, the power output unit 20 shall be considered as the configuration of the mimetic diagram of drawing 2 by setting the 2nd clutch 46 to ON and power shall be outputted to a driving shaft 22 from a motor MG 2 in motor driving torque control processing of an example, it is good also as what drives a driving shaft 22 by the motor MG 2 by setting both the clutches 45 and 46 of both to ON. Such motor driving torque control processing is made by the motor driving torque control routine of the modification illustrated to drawing 24 . Hereafter, motor driving torque control processing of this modification is explained briefly.

[0147] If the routine of this modification is performed, the control CPU 90 of a control device 80 will transmit first the signal which suspends operation of an engine 50 to EFIECU70 (step S420). EFIECU70 which received the signal which suspends operation of this engine 50 stops the fuel injection to an engine 50, and ignition, and suspends operation of an engine 50. Then, when it investigates whether both the 1st clutch 45 and the 2nd clutch 46 serve as ON (step S421) and both the clutches 45 and 46 of both will be in the condition of ON, both the clutches 45 and 46 are both made off (step S422). And a value 0 is set as torque command value Tc* of a motor MG 1 (step S423). Next, the engine speed Ne of

the crankshaft 56 of an engine 50 is read (step S424), and the friction torque Tef of an engine 50 is derived based on the read engine speed Ne (step S425). If it is torque required to rotate the engine 50 with which the friction torque Tef has suspended operation here at an engine speed Ne, and considers as a map beforehand in quest of the relation between the engine speed Ne of an engine 50, and the friction torque Tef by experiment etc., it memorizes to ROM in the example and an engine speed Ne is read, the friction torque Tef corresponding to the engine speed Ne read using this map shall be derived. And the drawn friction torque Tef, torque (torque command value) Td* which should be outputted to a driving shaft 22, and the applied value are set up as torque command value Ta* of a motor MG 2 (step S426), and control of a motor MG 1 and a motor MG 2 is performed so that a motor MG 1 and a motor MG 2 may operate with the set-up value (steps S427 and S428).

[0148] Thus, the torque (value Td*) according to the amount of accelerator pedal 64 treading in can be outputted to a driving shaft 22 by setting the friction torque Tef, torque command value Td*, and the applied value as motor driving torque control processing of a modification, then torque command value Ta* of a motor MG 2, carrying out motoring of the engine 50, where both the clutches 45 and 46 of both are set to ON. In addition, although derivation of the friction torque Tef of an engine 50 was performed in this modification based on the engine speed Ne of an engine 50, since both the clutches 45 and 46 of both were set to ON and the crankshaft 56 and the driving shaft 22 have joined together mechanically, of course, it is good also as what is derived based on the engine speed Nd of a driving shaft 22.

[0149] According to the operation control explained above, the power for which an operator asks can be outputted to a driving shaft 22. And since more efficient operation mode is chosen according to the remaining capacity BRM of the power (energy Pd) for which an operator asks, or a dc-battery 94, and the rotational frequency Nd of a driving shaft 22, energy efficiency of the whole equipment can be made higher. Furthermore, the energy loss of the motor MG 1 at the time of carrying out torque conversion of the power outputted from the engine 50 and a motor MG 2 can be made small by operating the 1st clutch 45 and the 2nd clutch 46 according to target engine-speed Ne* of an engine 50, and the engine speed Nd of a driving shaft 22 by each operation mode. Consequently, energy efficiency of the whole equipment can be made higher.

[0150] Although operation torque control processing, charge-and-discharge torque control processing, power assistant torque control processing, direct-output torque control processing, and motor driving torque control processing shall usually be chosen and performed in the operation control of an example according to the remaining capacity BRM of the power (energy Pd) for which an operator asks, or a dc-battery 94, and the rotational frequency Nd of a driving shaft 22, it does not interfere as what does not process the part of these processings.

[0151] Moreover, although direct-output torque control processing was performed in the operation control of an example when torque command value Td* which is the torque and the engine speed Nd of a driving shaft 22 which should be outputted to a driving shaft 22 were in the range (the field PA of drawing 8 ) which can operate an engine 50 efficiently When target engine-speed Ne* of an engine 50 and the engine speed Nd of a driving shaft 22 are within the limits of predetermined, or when the engine-speed difference Nc which is the deflection of the engine speed Ne of an engine 50 and the engine speed Nd of a driving shaft 22 is in predetermined within the limits, it is good also as what performs direct-output torque control processing. Usually, as for a motor, effectiveness becomes high most at the time of the operational status near the rated value, and effectiveness also becomes low at the time of the operational status which is remarkably separated from the operational status. The engine speed of a motor MG 1 is the engine-speed difference Nc which is the deflection of the engine speed Ne of an engine 50, and the engine speed Nd of a driving shaft 22, since it becomes the deflection of the target engine-speed Ne* of an engine 50 and the engine speed Nd of a driving shaft 22 in a steady state, when this deflection is small, a motor MG 1 will be operated at a small engine speed, and that effectiveness also becomes low. Therefore, if direct-output torque control processing is performed as mentioned above when the engine speed of a motor MG 1 is small, decline in the energy efficiency of the whole equipment by decline in the effectiveness of a motor MG 1 can be prevented by connecting a crankshaft 56 and a driving shaft 22 mechanically by setting both the 1st clutch 45 and the 2nd clutch 46

to ON. In addition, since the deflection of target torque Te* of an engine 50 and the torque (torque command value Td*) which should be outputted to a driving shaft 22 also becomes small when the deflection of the engine speed Nd of target engine-speed Ne* of an engine 50 and a driving shaft 22 is small, when it is usually in the range (the field PA of drawing 8 ) which can operate an engine 50 efficiently, it corresponds.

[0152] In the operation control of an example, when the torque (torque command value Td*) which should be outputted to a driving shaft 22, and the engine speed Nd of a driving shaft 22 were in the range (the field PA of drawing 8 ) which can operate an engine 50 efficiently, or when the engine speed Nd of a driving shaft 22 was within the limits of this even if there was no torque command value Td* within limits which can operate an engine 50 efficiently, direct-output torque control processing ( drawing 19 or drawing 20 ) was performed. Not only this case but when a certain abnormalities arise on a motor MG 1, it is good also as what outputs power to a driving shaft 22 from an engine 50 and a motor MG 2 by setting both the 1st clutch 45 and the 2nd clutch 46 to ON. In this case, what is necessary is to output power to a driving shaft 22 by the motor MG 2, where motoring of the engine 50 is carried out, and just to drive a car, when starting a car, or when [ when the vehicle speed is small ] the engine speed Nd of a driving shaft 22 turns into an engine speed below the minimum engine speed which can operate an engine 50. And what is necessary is to put an engine 50 into operation, when the engine speed Nd of a driving shaft 22 becomes more than the minimum engine speed which can operate an engine 50, to output the power outputted from an engine 50, and the power outputted from a motor MG 2 to a driving shaft 22, and just to drive a car. If it carries out like this, even when abnormalities arise on a motor MG 1, power can be outputted to a driving shaft 22 and a car can be driven.

[0153] Although motor driving torque control processing shall be performed in the operation control of an example when the energy Pd which should be outputted to a driving shaft 22 is judged that the rotational frequency Nd of a driving shaft 22 is smaller than the predetermined rotational frequency NML smaller than the predetermined energy PML, it is good also as what performs motor driving torque control processing irrespective of the rotational frequency Nd of the energy Pd which should be outputted to such a driving shaft 22, and a driving shaft 22. For example, when an operator sets to ON the motor drive mode setting switch which is not illustrated, it is good also as what performs motor driving torque control processing.

[0154] D. Explain starting control processing of the engine 50 in starting control of an engine, next the power output unit 20 of an example. In the power output unit 20 of an example, when a car is in a idle state, in case transit of a car is started by the above-mentioned motor driving torque control processing where the engine 50 besides in the case of putting an engine 50 into operation is suspended and it switches to a torque control besides after that, when putting an engine 50 into operation, namely, when a car is in a run state, an engine 50 may be put into operation. First, starting processing of the engine 50 in case a car is in a idle state is explained based on the engine starting manipulation routine of drawing 25 , and starting processing of the engine 50 in case a car is in a run state after that is explained.

[0155] The engine starting manipulation routine of drawing 25 is performed when a starting switch 79 is turned on by the operator. If this routine is performed, the control CPU 90 of a control device 80 will consider the power output unit 20 as the configuration of the mimetic diagram of drawing 3 by setting the 2nd clutch 46 to OFF (step S432) first while setting the 1st clutch 45 to ON (step S430). Then, the starter torque TST is set as torque command value Ta* of a motor MG 2 (step S434), and a motor MG 2 is controlled (step S436). At this time, torque command value Tc* of a motor MG 1 is set up (step S435), and a motor MG 1 is controlled so that power is not outputted to a driving shaft 22 through planetary gear 200 (step S436). Thus, motoring of the crankshaft 56 of an engine 50 is carried out by operating both the clutches 45 and 46 and controlling a motor MG 2. Here, the starter torque TST is set up as torque which the friction torque of an engine 50 can be overcome [ torque ] and can rotate an engine 50 at the rotational frequency more than the predetermined rotational frequency NST.

[0156] Next, the rotational frequency Ne of an engine 50 is read (step S437), and the read rotational frequency Ne is compared with the predetermined rotational frequency NST (step S438). Here, the predetermined engine speed NST is set up as an engine speed more than the minimum engine speed

which is stabilized and can carry out continuous running of the engine 50. When the rotational frequency Ne of an engine 50 is smaller than the predetermined rotational frequency NST, it returns to step S436, step S436 thru/or processing of S440 are repeated, and it waits for the rotational frequency Ne of an engine 50 to turn into more than the predetermined rotational frequency NST. If the rotational frequency Ne of an engine 50 becomes more than the predetermined rotational frequency NST, the signal which starts the fuel-injection control and ignition control by EFIECU70 will be transmitted to EFIECU70 (step S439), and this routine will be ended. In addition, EFIECU70 which received the signal which starts fuel-injection control and ignition control controls opening of the idle speed control valve which was mentioned above and which is not illustrated while starting the fuel-injection control from a fuel injection valve 51, and the ignition control in an ignition plug 62 so that an engine 50 may be operated with idle rpm.

[0157] According to engine starting processing in which it explained above, an engine 50 can be put into operation in the condition that the car has stopped. And since it considers as the condition that Rota 41 of a motor MG 2 was connected to the crankshaft 56, having set the 1st clutch 45 to ON and having used the 2nd clutch 46 as off and an engine 50 is rotated by the motor MG 2, it is not necessary to form the motor for starting of an engine 50 independently. Consequently, the whole equipment can be used as a compact.

[0158] Although motoring of the engine 50 was carried out by the motor MG 2 in engine starting processing of an example, having set the 1st clutch 45 to ON and having used the 2nd clutch 46 as off, it is good also as what carries out motoring of the engine 50 by the motor MG 1 where it made the 1st clutch 45 off and the 2nd clutch 46 is set to ON. In this case, what is necessary is just to perform the engine starting manipulation routine illustrated to drawing 26 . Hereafter, this processing is explained briefly.

[0159] If the engine starting manipulation routine of drawing 26 is performed, first, the control CPU 90 of a control device 80 will set the 1st clutch 45 to OFF, and will consider the power output unit 20 as the configuration of the mimetic diagram of drawing 2 by setting the 2nd clutch 46 to ON (steps S440 and S441). And while setting the starter torque TST as torque command value Tc* of a motor MG 1 (step S442), the predetermined current IST (IuST, IvST, IwST) is set as the current Ia (Iua, Iva, Iwa) passed to each phase of the three phase coil 44 of a motor MG 2 (step S443), and control of a motor MG 1 and a motor MG 2 is performed (steps S445 and S446). Here, the predetermined current IST is set up as a current value which makes a motor MG 2 generate the torque which a driving shaft 22 does not rotate even if it makes the starter torque TST act on a crankshaft 56. Thus, by controlling a motor MG 1 and a motor MG 2, the rotation is restricted by the motor MG 2, a driving shaft 22 is fixed, and motoring of the crankshaft 56 of an engine 50 is carried out by the motor MG 1 which outputs the starter torque TST. And it waits for the rotational frequency Ne of an engine 50 to turn into more than the predetermined rotational frequency NST like the engine starting manipulation routine of drawing 25 (steps S447 and S448), and the signal which starts the fuel-injection control and ignition control by EFIECU70 is transmitted to EFIECU70 (step S449).

[0160] Thus, an engine 50 can be put into operation by the motor MG 1 and the motor MG 2 in the condition that the car has also suspended the configuration of the mimetic diagram of drawing 2 which set the 1st clutch 45 to OFF and set the 2nd clutch 46 to ON. Therefore, it is not necessary to form the motor for [ ****** ] starting of an engine 50 independently in this case, and the whole equipment can be used as a compact.

[0161] Next, starting processing of the engine 50 in case a car is in a run state is explained. Starting processing of the engine 50 in case a car is in a run state is performed by the engine starting manipulation routine at the time of motorised [ which is illustrated to drawing 27 ]. This routine is performed when operation mode which is [ like / where an engine 50 is suspended, when motor driving torque control processing is made and the switch whose operator puts an engine 50 into operation, and which is not illustrated is set to ON, or when the remaining capacity BRM of a dc-battery 94 becomes smaller than a threshold BL ] different from motor drive mode by the operation mode judging manipulation routine of drawing 7 is set up. In addition, motor driving torque control processing sets to

OFF the processing 45 by the motor driving torque control routine illustrated to drawing 22 , i.e., the 1st clutch, considers the power output unit 20 as the configuration of the mimetic diagram of drawing 2 by setting the 2nd clutch 46 to ON, and is performed by the processing which outputs torque command value Td* to a driving shaft 22 from a motor MG 2 in this condition.

[0162] If this routine is performed, the control CPU 90 of a control unit 80 will set first the value which added the starter torque TST at torque command value Td* as torque command value Ta* of a motor MG 2 while setting the starter torque TST as torque command value Tc* of a motor MG 1 (step S450) (step S452). And each control of a motor MG 1 and a motor MG 2 is performed (steps S454 and S456). This routine is performed when the power output unit 20 is considered as the configuration of the mimetic diagram of drawing 2 , as mentioned above. If the starter torque TST is outputted to a crankshaft 56 from a motor MG 1 with this configuration, motoring of the engine 50 will be carried out by this torque. At this time, the torque according to the starter torque TST is outputted to a driving shaft 22 by operation of planetary gear 200 as reaction force. For this reason, torque smaller than the torque (torque command value Td*) which an operator wants will be outputted to a driving shaft 22, and a torque shock will produce only the thing which sets torque command value Td* as torque command value Ta* of a motor MG 2 like step S384 of the motor driving torque control routine of drawing 22 , then a part of anti-torque to be outputted to a driving shaft 22 from a motor MG 1 with starting of an engine 50. In the example, as shown in step S452, such a torque shock is negated by setting the value which added the starter torque TST at torque command value Td* as torque command value Ta* of a motor MG 2.

[0163] Thus, if motoring by the motor MG 1 of an engine 50 is performed, it will wait for the rotational frequency Ne of an engine 50 to turn into more than the predetermined rotational frequency NST like processing of steps S437 and S438 of the engine starting manipulation routine of drawing 25 (steps S458 and S460), and the signal which starts the fuel-injection control and ignition control by EFIECU70 will be transmitted to EFIECU70 (step S462).

[0164] According to the engine starting manipulation routine, a car can put an engine 50 into operation to the midst it is running only with the power outputted from a motor MG 2 at the time of motorised [ which was explained above / of an example ]. Since starting of this engine 50 is made by the motor MG 1, it does not independently need to form a motor in starting of an engine 50. And since the torque outputted to a driving shaft 22 from a motor MG 2 is controlled to negate the torque outputted to a driving shaft 22 from a motor MG 1 in the case of motoring of an engine 50, the torque shock produced in case an engine 50 is put into operation can be made small, or it can lose.

[0165] At the time of motorised [ of an example ], an engine starting manipulation routine When the motor driving torque control routine of drawing 22 which outputs desired torque (torque command value Td*) to a driving shaft 22 from a motor MG 2 where it set the 1st clutch 45 to OFF and the power output unit 20 is considered as the configuration of the mimetic diagram of drawing 2 by setting the 2nd clutch 46 to ON is performed Although it is the processing which puts an engine 50 into operation Where it set the 1st clutch 45 to ON and the power output unit 20 is considered as the configuration of the mimetic diagram of drawing 3 by setting the 2nd clutch 46 to OFF, while fixing a crankshaft 56 by the motor MG 2 Also when the motor driving torque control routine of drawing 23 which outputs torque command value Td* to a driving shaft 22 from a motor MG 1 is performed, starting of an engine 50 is made by an engine starting manipulation routine and the same control routine at the time of motorised [ which is illustrated to drawing 27 ].

[0166] According to this routine, an engine 50 can be put into operation to the midst it is running with the power outputted by acquiring reaction force from a motor MG 1 by the motor MG 2. Since starting of this engine 50 is made by the motor MG 2, it does not independently need to form a motor in starting of an engine 50. And since there is no fluctuation in the torque outputted to a driving shaft 22 from the motor MG 1 in the case of motoring of an engine 50, even in case an engine 50 is put into operation, there is no torque shock.

[0167] At the time of motorised [ of an example ], an engine starting manipulation routine When the motor driving torque control routine of drawing 22 which outputs desired torque (torque command value

Td*) to a driving shaft 22 from a motor MG 2 where it set the 1st clutch 45 to OFF and the power output unit 20 is considered as the configuration of the mimetic diagram of drawing 2 by setting the 2nd clutch 46 to ON is performed Although it is the processing which puts an engine 50 into operation When the motor driving torque control routine of drawing 24 which outputs desired torque (torque command value Td*) to a driving shaft 22 is performed carrying out motoring of the engine 50 by the motor MG 2 where both the 1st clutch 45 and the 2nd clutch 46 are set to ON Starting of an engine 50 is made by the engine starting manipulation routine at the time of motorised [ which is illustrated to drawing 28 ].

[0168] When an engine starting manipulation routine is performed at the time of motorised [ which is illustrated to this drawing 28 ], the control CPU 90 of a control unit 80 First, step S424 of the motor driving torque control routine of drawing 24 thru/or the same processing as S427, Namely, the rotational frequency Ne of an engine 50 reads (step S490). The friction torque Tef of an engine 50 is drawn based on the read engine speed Ne (step S491). Torque command value Td* is added to the derived friction torque Tef, torque command value Ta* of a motor MG 2 is set up (step S492), and a motor MG 2 is controlled (step S493).

[0169] Next, the read rotational frequency Ne is judged that there is nothing to the rotational frequency which is stabilized and can operate an engine 50 when a rotational frequency Ne is smaller than the predetermined rotational frequency NST as compared with the predetermined rotational frequency NST (step S438), and step S490 thru/or processing of S494 are repeated until it returns to step S490 and a rotational frequency Ne turns into more than the predetermined rotational frequency NST. Thus, step S424 of the motor driving torque control routine of drawing 24 thru/or the same processing as S427 are repeated because it performs while this starting manipulation routine is driving by the motor MG 2. That is, it is because the crankshaft 56 and the driving shaft 22 are combined with the 1st clutch 45 and the 2nd clutch 46, so priority cannot be given to the rotational frequency Ne of an engine 50 over the rotational frequency Nd of a driving shaft 22 and it cannot be controlled.

[0170] When the engine speed Ne of an engine 50 is more than the predetermined engine speed NST, the fuel oil consumption when it being no-load and operating an engine 50 at an engine speed Ne is computed (step S495), and a signal is transmitted towards EFIECU70 so that the fuel-injection control and ignition control which inject the computed fuel oil consumption from a fuel injection valve 51 may be carried out (step S496). Here, it was no-load, and in the example, beforehand in quest of the engine speed Ne and the fuel oil consumption at the time of the engine 50 of unloaded condition, it memorized to ROM as a map by experiment etc., and the fuel oil consumption at the time of an engine speed Ne was calculated by deriving the fuel oil consumption corresponding to an engine speed Ne from this map, when the engine speed Ne was given. And torque command value Td* is set as torque command value Ta* of a motor MG 2 (step S497), a motor MG 2 is controlled (step S498), and this routine is ended. Thus, as for an engine 50, it is no-load to remove the friction torque Tef of an engine 50 from count of a setup of torque command value Ta* of a motor MG 2, and it is because it is operated at a rotational frequency Ne.

[0171] According to the engine starting manipulation routine, an engine 50 can be put into operation to the midst which is outputting power to the driving shaft 22 at the time of motorised [ which was explained above / of a modification ], rotating an engine 50 by the motor MG 2. And it is no-load in an engine 50, and since torque command value Td* is set as torque command value Ta* of a motor MG 2 while adjusting fuel oil consumption so that it may be operated at a rotational frequency Ne, the torque shock at the time of putting an engine 50 into operation can be made small. In addition, at the time of motorised [ of a modification ], in an engine starting manipulation routine, although it shall be no-load and an engine 50 shall be operated at a rotational frequency Ne, it is good also as what is operated at a rotational frequency Ne with the load torque Te. In this case, what is necessary is just to set what subtracted the load torque Te from torque command value Td* as torque command value Ta* of a motor MG 2, in order to make small the torque shock in the case of starting of an engine 50. At the time of motorised [ of a modification ], moreover, in an engine starting manipulation routine Although step S490 thru/or processing of S494 shall be repeated at step S494 when the rotational frequency Ne of an engine 50 is smaller than the predetermined rotational frequency NST since priority cannot be given to

the rotational frequency Ne of an engine 50 over the rotational frequency Nd of a driving shaft 22 and it cannot be controlled When the power output unit 20 is carried in what can change the rotational frequency Nd of a driving shaft 22 into comparison **** freedom, for example, a vessel, and the aircraft, it is good also as what gives priority to the rotational frequency Ne of an engine 50 over the rotational frequency Nd of a driving shaft 22, and controls it.

[0172] E. Explain the control at the time of reversing a car with go-astern control, next the power output unit 20 of an example. Go-astern control of a car is made by the torque control routine at the time of the go-astern illustrated to drawing 29 . This routine is repeatedly performed for every (every [ for example, ] 8msec) predetermined time, when the shift position sensor 84 detects that the shift lever 82 was set to the location of reverse by the operator.

[0173] If this routine is performed, when [ both ] it investigates whether the control CPU 90 of a control device 80 has the 1st off clutch 45, and the 2nd clutch 46 is in the condition (condition of the configuration of the mimetic diagram of drawing 2 ) of ON first (step S500) and will be in this condition, once setting both the clutches 45 and 46 to OFF, (step S502) and the 2nd clutch 46 are set to ON (step S504). When changing into the condition that both the clutches 45 and 46 should set up, the reason for both [ once ] making both the clutches 45 and 46 off was explained. Next, while reading the engine speed Nd of a driving shaft 22 (step S506), the torque (torque command value Td*) which should read the accelerator pedal position AP detected by accelerator pedal position sensor 64a (step S508), and should output it to a driving shaft 22 based on the engine speed Nd of the read driving shaft 22 and the accelerator pedal position AP is derived. Although the technique of derivation of such torque command value Td* is the same as the technique explained by processing of step S104 of the operation control routine of drawing 5 , since the shift lever 82 is set as reverse, a negative value is drawn as torque command value Td* here.

[0174] If torque command value Td* is derived, the remaining capacity BRM of a dc-battery 94 is read (step S512), and the remaining capacity BRM of the read dc-battery 94 is measured with a threshold BL (step S514). When it judges that the remaining capacity BRM of a dc-battery 94 is in sufficient condition to drive a motor MG 2 when the remaining capacity BRM of a dc-battery 94 is beyond the threshold BL, it investigates whether the engine 50 is operated (step S516) and the engine 50 is operated, the signal which makes an engine 50 idle operational status is transmitted to EFIECU70 (step S518).

[0175] On the other hand, when the remaining capacity BRM of a dc-battery 94 is under the threshold BL at step S514, first, the energy Pd which should multiply the torque (torque command value Td*) which should be outputted to a driving shaft 22 by the rotational frequency Nd of a driving shaft 22, and should be outputted to a driving shaft 22 is computed (step S523), and target torque Te* of an engine 50 and target rotational frequency Ne* are set up based on the computed energy Pd (step S524). Here, the technique of setting up target torque Te* of an engine 50 and target rotational frequency Ne* is the same as the technique explained at step S170 in drawing 9 and the usual operation torque control of drawing 10 . In addition, as mentioned above, torque command value Td* is a negative value, but since it is a time of reversing a car and the rotational frequency Nd of a driving shaft 22 also serves as a negative value, Energy Pd serves as a forward value like the time of advancing a car.

[0176] The torque set as torque command value Tc* of a motor MG 1 by the top type (1) based on target torque Te* of an engine 50 is set up. Next, to torque command value Ta* of a motor MG 2 The torque of the difference of the torque and torque command value Td* which are outputted to a driving shaft 22 according to target torque Te* of an engine 50 is set up (step S530), and each control of a motor MG 1, a motor MG 2, and an engine 50 is performed (step S532). Although the engine 50 is rotating in the forward direction when the remaining capacity BRM of a dc-battery 94 is judged to be under the threshold BL at step S514, it comes to reverse a driving shaft 22 by rotating a motor MG 1 at a rotational frequency higher than the rotational frequency of an engine 50.

[0177] According to go-astern control of the car explained above, a car can be reversed. When the remaining capacity BRM of a dc-battery 94 is enough, a car can be reversed by outputting power from a motor MG 2 using the power which discharges from a dc-battery 94. Moreover, a car can be reversed

when the hand of cut of an engine 50 carries out torque conversion of the power outputted from an engine 50 by the motor MG 1 and the motor MG 2 at the power of the reverse sense. Since the go-astern by this torque conversion can be performed irrespective of the remaining capacity BRM of a dc-battery 94, a car can be reversed, even when the remaining capacity BRM of a dc-battery 94 is inadequate and the discharge from a dc-battery 94 cannot make.

[0178] Although torque conversion of all the energy Pe outputted from an engine 50 shall be carried out by the motor MG 1 and the motor MG 2 and it shall output to a driving shaft 22 in go-astern control of the car of an example when the remaining capacity BRM of a dc-battery 94 is under the threshold BL It is good also as what provides a part of energy Pd which shall charge a dc-battery 94 by a part of energy Pe outputted from an engine 50, or should be outputted to a driving shaft 22 by discharge from a dc-battery 94. In this case, what is necessary is just to set up target torque Te* of an engine 50, and target rotational frequency Ne* according to the energy Pe of a value smaller than Energy Pe and Energy Pd of a bigger value than the energy Pd which should be outputted to a driving shaft 22.

[0179] Although the 1st clutch 45 was set to OFF and the power output unit 20 reversed the car as a configuration of the mimetic diagram of drawing 2 by setting the 2nd clutch 46 to ON in go-astern control of the car of an example, it is good also as what the 1st clutch 45 is set [ what ] to ON and the power output unit 20 reverses a car as a configuration of the mimetic diagram of drawing 3 by setting the 2nd clutch 46 to OFF as for. In this case, what is necessary is just to perform a torque control routine at the time of the go-astern illustrated to drawing 30 . The point of operating both the clutches 45 and 46 so that a torque control routine may set the 1st clutch 45 to ON and it may become the configuration of the mimetic diagram of drawing 3 about the power output unit 20 by setting the 2nd clutch 46 to OFF at the time of go-astern of this drawing 30 (step S540 thru/or S544), Except for the point that the values set as torque command value Tc* of a motor MG 1 and torque command value Ta* of a motor MG 2 based on the on-off conditions of both such clutches 45 and 46 differing differ, it is the same as that of a torque control routine at the time of go-astern of drawing 29 .

[0180] It sets to a torque control routine at the time of go-astern of drawing 30 . The control CPU 90 of a control unit 80 When the remaining capacity BRM of a dc-battery 94 is beyond the threshold BL at step S554 The torque which can output torque command value Td* to a driving shaft 22 as torque command value Tc* of a motor MG 1 based on an upper type (1) is set up, and the torque equivalent to the anti-torque of a motor MG 1 is set up as torque command value Ta* of a motor MG 2 (step S570). In addition, when an engine 50 is in the condition of shutdown, it is good also as what carries out the lock-up of the motor MG 2. Moreover, when making an engine 50 into idle operational status, it is good also as what carries out feedback control of torque command value Ta* of a motor MG 2 so that the engine speed Ne of a crankshaft 56 may turn into idle rpm.

[0181] On the other hand, although torque command value Tc* of a motor MG 1 is the same as that of **** when the remaining capacity BRM of a dc-battery 94 is under the threshold BL at step S554, the value which subtracted target torque Te* of an engine 50 from the torque command value equivalent to anti-torque is set as torque command value Ta* of a motor MG 2 (step S570).

[0182] A car can be reversed also by go-astern control of the modification explained above. When the remaining capacity BRM of a dc-battery 94 is enough, while outputting power from a motor MG 1 using the power which discharges from a dc-battery 94, a car can be reversed by responding to the reaction force by the motor MG 2. Moreover, a car can be reversed when the hand of cut of an engine 50 carries out torque conversion of the power outputted from an engine 50 by the motor MG 1 and the motor MG 2 at the power of the reverse sense. Since the go-astern by this torque conversion can be performed irrespective of the remaining capacity BRM of a dc-battery 94, a car can be reversed, even when the remaining capacity BRM of a dc-battery 94 is inadequate and the discharge from a dc-battery 94 cannot make.

[0183] Although torque conversion of all the energy Pe outputted from an engine 50 shall be carried out by the motor MG 1 and the motor MG 2 and it shall output to a driving shaft 22 in go-astern control of a modification when the remaining capacity BRM of a dc-battery 94 is under the threshold BL It is good also as what provides a part of energy Pd which shall charge a dc-battery 94 by a part of energy Pe

outputted from an engine 50, or should be outputted to a driving shaft 22 by discharge from a dc-battery 94. In this case, what is necessary is just to set up target torque Te* of an engine 50, and target rotational frequency Ne* according to the energy Pe of a value smaller than Energy Pe and Energy Pd of a bigger value than the energy Pd which should be outputted to a driving shaft 22.

[0184] F. Explain both other operation controls, and next both clutches 45 and 46 based on drawing 31 about the actuation at the time of setting to OFF. If the torque control routine of drawing 31 is performed, the control CPU 90 of a control device 80 will set first torque command value Td* which is the torque which should be outputted to a driving shaft 22 as target torque Te* of an engine 50 (step S600). Then, it investigates whether both the 1st clutch 45 and the 2nd clutch 46 are off (step S602), and when neither of both clutches 45 and 46 are off, both the clutches 45 and 46 are both made off (step S604). Next, the rotational frequency Nd of a driving shaft 22 is read (step S606). And processing which reads the minimum rotational frequency N1 and maximum engine speed N2 in the range (the field PA of drawing 8 ) which can operate efficiently the engine 50 in torque command value Td* which is the torque which should be outputted to a driving shaft 22 is performed (step S608), and it compares with the minimum rotational frequency N1 and maximum engine speed N2 which read the rotational frequency Nd of a driving shaft 22 (step S610). In addition, in the example, reading of the minimum engine speed N1 and maximum engine speed N2 memorizes beforehand the engine 50 to each torque command value Td* to ROM in quest of the minimum engine speed N1 and maximum engine speed N2 of the range which can be operated efficiently by experiment etc., and if torque command value Td* is drawn, it shall derive the minimum engine speed N1 and maximum engine speed N2 from this torque command value Td* and map.

[0185] If the rotational frequency Nd of a driving shaft 22 is two or less maximum engine speed N at the one or more minimum rotational frequencies N The rotational frequency it is decided by the top formula (1) based on the rotational frequency Nd of a driving shaft 22 that will be target rotational frequency Ne* of an engine 50 is set up (step S614). When the rotational frequency Nd of a driving shaft 22 is the less than one minimum rotational frequency N, the minimum rotational frequency N1 is set as target rotational frequency Ne* (step S612), and when the rotational frequency Nd of a driving shaft 22 is larger than maximum engine speed N2, maximum engine speed N2 is set as target rotational frequency Ne* (step S616). Thus, by setting up, the operation point of target torque Te* of an engine 50 and target engine-speed Ne* becomes in the range (the field PA of drawing 8 ) which can operate efficiently the engine 50 mentioned above.

[0186] Then, while setting up the torque which becomes settled by the top type (1) as torque command value Tc* of a motor MG 1 based on target torque Te* of an engine 50 (step S618), a value 0 is set as torque command value Ta* of a motor MG 2 (step S620), and each control (step S622 thru/or S626) of a motor MG 1, a motor MG 2, and an engine 50 is performed.

[0187] Drawing 32 is an explanatory view which illustrates signs that power is outputted to the driving shaft 22 at the time of performing the torque control routine of such drawing 31 . When torque command value Td* which the driving shaft 22 is rotating at the rotational frequency Nd1, and becomes settled now according to the amount of treading in of an accelerator pedal 64 is a value Td1, the time of wanting to operate a driving shaft 22 on the operation point Pd 1 is considered. In addition, the following explanation explains as that to which gear ratio rho of planetary gear 200 is set so that the torque outputted to a driving shaft 22 and the output torque of an engine 50 may become the same value. In drawing 32 , although the torque Td1 (torque command value Td*) which should be outputted to a driving shaft 22 is in the range PA which can operate an engine 50 efficiently, the rotational frequency Nd1 of a driving shaft 22 is in the condition which is much less than the minimum of this range PA. At this time, torque command value Td* (value Td1) is set as target torque Te* of an engine 50 (step S600). Since the rotational frequency (value Ne1) of the lower limit of the range PA in torque Td1 is set as target rotational frequency Ne* of an engine 50 as the minimum rotational frequency N1 (step S612) An engine 50 will be operated on the operation point Pe1 with which it is expressed at torque Td1 and a rotational frequency Ne1. Since a motor MG 1 will be operated according to the rotational frequency difference Nc1 (forward value) of the rotational frequency Ne1 of an engine 50, and the rotational

frequency Nd1 of a driving shaft 22 at this time, the power (Td1xNc1) according to this rotational frequency difference Nc1 will be revived. This regeneration power is used for charge of a dc-battery 94.
[0188] Next, the time of the driving shaft 22 rotating at the rotational frequency Nd2, and wanting to operate a driving shaft 22 on the operation point Pd 2 in drawing 32 , when output-torque command value Td* is a value Td2 is considered. Although the torque Td2 (torque command value Td*) which should be outputted to a driving shaft 22 is in the range PA which can operate an engine 50 efficiently, the rotational frequency Nd2 of a driving shaft 22 is in the condition exceeding the upper limit of this range PA. At this time, torque command value Td* (value Td2) is set as target torque Te* of an engine 50 (step S600). Since the rotational frequency (value Ne2) of the upper limit of the range PA in torque Td2 is set as target rotational frequency Ne* of an engine 50 as maximum engine speed N2 (step S616) An engine 50 will be operated on the operation point Pe2 expressed with torque Te 2 and a rotational frequency Nd2. Since a motor MG 1 will be operated according to the rotational frequency difference Nc2 (negative value) of the rotational frequency Ne2 of an engine 50, and the rotational frequency Nd2 of a driving shaft 22 at this time, the power (Td2xNc2) according to this rotational frequency difference Nc2 will be consumed. The power consumed by this motor MG 1 is provided by discharge from a dc-battery 94.
[0189] When both the torque (torque command value Td*) which should be outputted to a driving shaft 22, and the engine speed Nd of a driving shaft 22 are in the range (the field PA of drawing 32 ) which can operate an engine 50 efficiently, torque command value Td* is set as target torque Te* of an engine 50 (step S600), and the engine speed Nd of a driving shaft 22 is set as target engine-speed Ne* of an engine 50 (step S614). Therefore, the rotational frequency Ne of an engine 50 and the rotational frequency Nd of a driving shaft 22 serve as the same value.
[0190] If the torque (torque command value Td*) which according to the torque control routine explained above should be outputted to a driving shaft 22 even if there is no engine speed Nd of a driving shaft 22 into the range (the field PA of drawing 8 ) which can operate an engine 50 efficiently is within the limits of this, the torque equivalent to torque command value Td* can output to a driving shaft 22 by setting both the clutches 45 and 46 to OFF, operating an engine 50 within limits which can be operated efficiently.
[0191] Such a torque control routine is not limited to the control when being within limits to which above-mentioned torque command value Td* can operate an engine 50 efficiently. For example, when a certain abnormalities arise on a motor MG 2, it is good also as what changes a rotational frequency into a driving shaft 22 by the motor MG 1, and outputs the power which both makes off the 1st clutch 45 and the 2nd clutch 46, and is outputted from an engine 50.
[0192] G. Although the 1st clutch 45 and the 2nd clutch 46 have been arranged between a motor MG 2 and a motor MG 1 in the power output unit 20 of an example explained beyond the modification As are shown in power output unit 20A of the modification of drawing 33 , and 1st clutch 45A and 2nd clutch 46B are arranged between an engine 50 and a motor MG 2 or are shown in power output unit 20B of the modification of drawing 34 1st clutch 45B is arranged between an engine 50 and a motor MG 2, and 2nd clutch 46B is good also as what is arranged between a motor MG 2 and a motor MG 1. Moreover, although the motor MG 2 has been arranged between an engine 50 and a motor MG 1 in the power output unit 20 of an example, as shown in power output unit 20C of the modification of drawing 35 , it is good also as what arranges a motor MG 1 between an engine 50 and a motor MG 2.
[0193] Moreover, various association with an engine, motors MG1 and MG2, and planetary gear is also possible. For example, in the power output unit 20 of an example, the motor MG 1 was combined with the sun gear 221, and the engine 50 was combined with the planetary carrier 223. On the other hand, as shown in the power output unit of drawing 36 , a motor MG 1 can be combined with a planetary carrier, and an engine can also be combined with a sun gear. Of course, what changed various integrated states with other gears can be considered.
[0194] Although the motor MG 1 and the motor MG 2 have been arranged on the same axle in the power output unit 20 of an example, as shown in power output unit 20E of the modification of drawing 37 , it is good also as what stations both on a different shaft. a shaft top which arranges an engine 50,

and a motor MG 1 and planetary-gear 200E on the same axle, and is different in a motor MG 2 in power output unit 20E of a modification -- arranging -- **** -- the ring wheel of planetary-gear 200E -- **** -- the good crankshaft is combined with one shaft of Clutches 45E and 46E with the belt, respectively.
[0195] Moreover, as shown in power output unit 20F of drawing 38 , a motor MG 2 may be arranged for an engine 50 on the same axle, and a motor MG 1 and planetary-gear 200F may be arranged on a different shaft. In this configuration, as for the engine crankshaft, one revolving shaft of clutch 46F is combined with the ring wheel shaft of planetary-gear 200F by the planetary carrier by the belt, respectively. Moreover, the ring wheel is combined with the driving shaft 22 by the belt.
[0196] The die length of the thing which arranges a motor MG 1 and a motor MG 2 on a different shaft like these modifications, then the shaft orientations of equipment can be shortened sharply. Consequently, it can consider as a thing advantageous to carrying equipment in a front-wheel driven car. Some which arrange such a motor MG 1 and Motor MG 2 on a different shaft have the degree of freedom of arrangement, such as the 1st clutch 45 and the 2nd clutch 46.
[0197] Although it was made to become a shaft top which is different in the crankshaft 56 and driving shaft 22 of an engine 50 in power output unit 20E which arranges a motor MG 1 and a motor MG 2 on a different shaft, or power output unit 20F, it is good also as what is made into a same axle top. Moreover, although between different shafts was combined with the belt in power output unit 20E of a modification, as shown in power output unit 20G of the modification of drawing 39 , it is good also as what is combined by gear association by the gear 102 and gear 104 which were attached in the crankshaft 56 and the driving shaft 22, and the gear 106 and gear 108 which were combined with one revolving shaft of planetary-gear 200G and clutch 46G.
[0198] Although the clutch performed connection with a motor MG 2, a crankshaft 56, or a driving shaft 22, and its discharge in the power output unit 20 of an example, as shown in power output unit 20H of the modification of drawing 40 , it is good also as what is performed by switch of gear association. The configuration of power output unit 20H of a modification is explained briefly. The gear 102 attached in the crankshaft 56 Rota revolving-shaft 38H [ of a modification ] of power output unit 20H, the gear 106 in which gear association is possible, and the gear 104 attached in the driving shaft 22 and the gear 108 in which gear association is possible are attached in the arrangement to which both gear association is carried out alternatively so that it may illustrate. Moreover, the actuator 100 made to move Rota revolving-shaft 38H to shaft orientations is formed in the edge in which the gear 108 of Rota revolving-shaft 38H was attached. Therefore, by driving this actuator 100, by making Rota revolving-shaft 38H slide to shaft orientations, as shown in drawing 40 (a) and drawing 40 (b), gear association with a gear 102 and a gear 106 and gear association with a gear 104 and a gear 108 can carry out alternatively.
[0199] Although connection between the Rota revolving shaft 38 and a crankshaft 56 and connection between the Rota revolving shaft 38 and a driving shaft 22 were made with the 1st clutch 45 and the 2nd clutch 46 in the power output unit 20 of an example, it is good also as what makes such connection combining a change gear and a clutch. for example, it is shown in power output unit 20J of the modification of drawing 41 -- as -- a crankshaft 56 and the Rota revolving shaft -- a change gear 120 and the 1st -- clutch 45J -- connecting -- a driving shaft 22 and the Rota revolving shaft -- a change gear 130 and the 2nd -- it is good also as what is connected by clutch 46J. The change gear 120 consists of a belt 125 held at the belt attachment components 122 and 124 of the pair attached in the crankshaft 56, and two pairs of belt attachment components 122,124, and an actuator 126 for changing the path of the belt attachment component 124. Therefore, in a change gear 120, by changing the circumference radius of the belt 125 of the belt attachment component 124 with an actuator 126, it can change gears and the rotational frequency of a crankshaft 56 can be transmitted to the Rota revolving shaft. The change gear 130 attached in the 2nd clutch 46J side is also carrying out the same configuration.
[0200] According to power output unit 20J of a modification equipped with such a change gear 120 and a change gear 130, a change gear 120 and a change gear 130 can adjust the rotational frequency of the Rota revolving shaft. Consequently, a motor MG 2 can be operated on the more efficient operation point. Moreover, Clutches 45J and 46J are smoothly connectable by adjusting a change gear ratio with a change gear 120. consequently, the 1st -- the torque shock which may be produced at the time of

connection by clutch 45J can be made small.
[0201] Although the change gear 120,130 was prepared for the both sides of connection, it is good power output unit 20J of a modification also as a thing of connection between a crankshaft 56 and Rota revolving-shaft 38J, a driving shaft 22, and Rota revolving-shaft 38J to prepare only in either. Moreover, although a rotational frequency shall be changed gears by the technique of changing the circumference radius of a belt 125 in power output unit 20J of a modification, since what kind of thing may be used as long as it can change gears and can transmit the rotational frequency of Rota revolving-shaft 38J to a crankshaft 56 or a driving shaft 22, it is good also as what changes gears by gear association of planetary gear etc.
[0202] As mentioned above, although the gestalt of operation of this invention was explained, as for this invention, it is needless to say that it can carry out with the gestalt which becomes various within limits which are not limited to the gestalt of such operation at all, and do not deviate from the summary of this invention.
[0203] For example, although the gasoline engine operated with a gasoline as an engine 50 was used in the power output unit 20 of the example mentioned above, various kinds of internal combustion, such as a diesel power plant, a turbine engine, and a jet engine, or an external combustion engine can also be used.
[0204] Moreover, in the power output unit 20 of an example, although PM form (permanent magnet form-ermanent Magnet type) synchronous motor was used as a motor MG 1 and a motor MG 2, if regeneration actuation and a powering movement are made to perform, VR form (adjustable reluctance form; Variable Reluctance type) synchronous motor, a vernier motor, a direct current motor, an induction motor, a superconducting motor, a step motor, etc. can also be used.
[0205] Or in the power output unit 20 of an example, although the transistor inverter was used as 1st and 2nd drive circuits 91 and 92, an IGBT (insulated-gate bipolar mode transistor; Insulated Gate Bipolar mode Transistor) inverter, a thyristor inverter, an electrical-potential-difference PWM (pulse-width-modulation-ulse Width Modulation) inverter, a square wave inverter (an electrical-potential-difference form inverter, current form inverter), a resonance inverter, etc. can also be used.
[0206] Moreover, as a dc-battery 94, although Pb dc-battery, a NiMH dc-battery, Li dc-battery, etc. can be used, it can replace with a dc-battery 94 and a capacitor can also be used.
[0207] Although the power output unit 20 of an example furthermore explained the case where a power output unit was carried in a car, this invention is not limited to this and, in addition to this, can also be carried [ means of transportation, such as a vessel and an aircraft, and ] in various industrial machines etc.

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[Translation done.]

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## TECHNICAL PROBLEM

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[Problem(s) to be Solved by the Invention] However, such a conventional power output unit had the problem of producing the case where the effectiveness of the whole equipment falls, when the rotational frequency of a driving shaft became large. In an above-mentioned power output unit, if it is going to output power to a driving shaft with a magnetic coupling even when the rotational frequency of a driving shaft becomes large, the rotational frequency of a prime mover must be carried out more than the rotational frequency of a driving shaft. since it usually comes out that the range has become settled by that rotational frequency and load torque and the field of the efficient operation point of a prime mover has it, while the driving shaft is rotating at the rotational frequency exceeding that range, the operation point efficient [ a prime mover ] will be out of range, and it must operate, consequently the effectiveness of the whole equipment will fall.
[0004] As one of the solutions to such a problem, these people replaced with the magnetic coupling in JP,9-308012,A, and have proposed the equipment using the planetary gear combined with the revolving shaft of a generator and this generator, the output shaft of a prime mover, and the driving shaft that has a motor. This outputs the power demanded by acting as the power running of the motor with which the driving shaft was equipped using this power after distributing the power outputted from a prime mover to two by planetary gear and changing the part into power with the generator from a driving shaft. When the rotational frequency of a driving shaft becomes large, it carries out power running conversely, using a generator as a motor, the rotational frequency of a driving shaft is accelerated taking advantage of the property of planetary gear, and operation of a prime mover is enabled at a rotational frequency smaller than the rotational frequency of a driving shaft. Power required in order to act as the power running of the generator at this time is provided by operating a motor as a generator.
[0005] However, with the equipment of this proposal, when the rotational frequency of a driving shaft became larger than the rotational frequency of a prime mover, the technical problem that operation effectiveness will become low even if it is not comparable to conventional equipment occurred. When the rotational frequency of a driving shaft becomes larger than the rotational frequency of a prime mover as mentioned above, it acts as the power running of the generator using the power revived by the motor combined with ******. A part of power outputted to ****** from the generator is again revived as power by the motor. That is, a part of power circulates between a generator and a motor. Generally in conversion with mechanical power and power, the loss by the conversion efficiency of equipment arises. Therefore, existence of the circulating power which was mentioned above makes the operation effectiveness of equipment fall.
[0006] The power output unit and its control approach of this invention solve such a trouble, and set to one of the purposes to propose the control approach of the equipment which outputs more efficiently the power outputted from a prime mover to a driving shaft, and such equipment. Moreover, the power output unit and its control approach of this invention set to one of the purposes to propose the equipment which outputs power to a driving shaft efficiently, and the control approach of the equipment, even when the rotational frequency of a driving shaft becomes larger than the rotational frequency of a prime mover.

[Translation done.]

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## DESCRIPTION OF DRAWINGS

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[Brief Description of the Drawings]
[Drawing 1] It is the block diagram showing the outline configuration of the power output unit 20 as the 1st example of this invention.
[Drawing 2] It is a mimetic diagram showing the configuration of the power output unit 20 of the example when setting the 1st clutch 45 to OFF and setting the 2nd clutch 46 to ON.
[Drawing 3] It is a mimetic diagram showing the configuration of the power output unit 20 of the example when setting the 1st clutch 45 to ON and making the 2nd clutch 46 off.
[Drawing 4] It is the explanatory view which explains the situation of the torque conversion at the time of Ne<Nd with the configuration of the mimetic diagram of drawing 2 .
[Drawing 5] It is the flow chart which illustrates the operation control routine performed by the control CPU 90 of a control device 80.
[Drawing 6] It is the explanatory view which illustrates the map in which torque command value Td*, an engine speed Nd, and relation with the accelerator pedal position AP are shown.
[Drawing 7] It is the flow chart which illustrates the operation mode judging manipulation routine performed by the control CPU 90 of a control device 80.
[Drawing 8] It is the explanatory view showing an example of the range which can operate an engine 50 efficiently.
[Drawing 9] It is the flow chart which is performed by the control CPU 90 of a control device 80 and which usually illustrates a part of operation torque control routine.
[Drawing 10] It is the flow chart which is performed by the control CPU 90 of a control device 80 and which usually illustrates a part of operation torque control routine.
[Drawing 11] It is the graph which illustrates the operation point of an engine 50, and the relation of effectiveness.
[Drawing 12] Energy Pe is the graph which illustrates the relation between the effectiveness of the operation point of the engine 50 in alignment with a fixed curve, and the rotational frequency Ne of an engine 50.
[Drawing 13] It is the flow chart which illustrates the clutch motor control routine performed by the control CPU 90 of a control device 80.
[Drawing 14] It is the flow chart which illustrates a part of charge-and-discharge torque control routine performed by the control CPU 90 of a control device 80.
[Drawing 15] It is the flow chart which illustrates a part of charge-and-discharge torque control routine performed by the control CPU 90 of a control device 80.
[Drawing 16] It is the graph which shows an example of the relation between the remaining capacity BRM of a dc-battery 94, and the power which can be charged.
[Drawing 17] It is the flow chart which illustrates a part of power assistant torque control routine performed by the control CPU 90 of a control device 80.
[Drawing 18] It is the flow chart which illustrates a part of power assistant torque control routine performed by the control CPU 90 of a control device 80.

[Drawing 19] It is the flow chart which illustrates the direct-output torque control routine performed by the control CPU 90 of a control device 80.
[Drawing 20] It is the flow chart which illustrates the direct-output torque control routine of a modification.
[Drawing 21] It is the explanatory view which illustrates signs that power is outputted to a driving shaft 22 by the direct-output torque control routine of a modification.
[Drawing 22] It is the flow chart which illustrates the motor driving torque control routine performed by the control CPU 90 of a control device 80.
[Drawing 23] It is the flow chart which illustrates the motor driving torque control routine of a modification.
[Drawing 24] It is the flow chart which illustrates the motor driving torque control routine of a modification.
[Drawing 25] It is the flow chart which illustrates the engine starting manipulation routine performed by the control CPU 90 of a control device 80.
[Drawing 26] It is the flow chart which illustrates the engine starting manipulation routine of a modification.
[Drawing 27] It is the flow chart which illustrates an engine starting manipulation routine at the time of motorised [ which is performed by the control CPU 90 of a control device 80 ].
[Drawing 28] It is the flow chart which illustrates an engine starting manipulation routine at the time of motorised [ of a modification ].
[Drawing 29] It is the flow chart which illustrates a torque control routine at the time of the go-astern performed by the control CPU 90 of a control device 80.
[Drawing 30] It is the flow chart which illustrates a torque control routine at the time of go-astern of a modification.
[Drawing 31] When it considers as the configuration of the mimetic diagram of drawing 10 , it is the flow chart which illustrates the torque control routine performed by the control CPU 90 of a control device 80.
[Drawing 32] It is the explanatory view which illustrates signs that power is outputted to a driving shaft 22 by the torque control routine of drawing 31 .
[Drawing 33] It is the block diagram showing the outline configuration of power output unit 20A of a modification.
[Drawing 34] It is the block diagram showing the outline configuration of power output unit 20B of a modification.
[Drawing 35] It is the block diagram showing the outline configuration of power output unit 20C of a modification.
[Drawing 36] It is the block diagram showing the outline configuration of power output unit 20D of a modification.
[Drawing 37] It is the block diagram showing the outline configuration of power output unit 20E of a modification.
[Drawing 38] It is the block diagram showing the outline configuration of power output unit 20F of a modification.
[Drawing 39] It is the block diagram showing the outline configuration of power output unit 20G of a modification.
[Drawing 40] It is the block diagram showing the outline configuration of power output unit 20H of a modification.
[Drawing 41] It is the block diagram showing the outline configuration of power output unit 20J of a modification.
[Description of Notations]
20 -- Power output unit
20A-20J -- Power output unit
22 -- Driving shaft

24 -- Differential gear
26 28 -- Driving wheel
31 -- Rota
33 -- Stator
41 -- Rota
42 -- Permanent magnet
43 -- Stator
44 -- Three phase coil
45 -- The 1st clutch
46 -- The 2nd clutch
49 -- Case
50 -- Engine
51 -- Fuel injection valve
52 -- Combustion chamber
54 -- Piston
56 -- Crankshaft
58 -- Ignitor
60 -- Distributor
62 -- Ignition plug
64 -- Accelerator pedal
64a -- Accelerator pedal position sensor
65 -- Brake pedal
65a -- Brake-pedal position sensor
66 -- Throttle valve
67 -- Throttle-valve position sensor
68 -- Actuator
70 -- EFIECU
72 -- Inlet-pipe negative pressure sensor
74 -- Coolant temperature sensor
76 -- Rotational frequency sensor
78 -- Angle-of-rotation sensor
79 -- Starting switch
80 -- Control unit
82 -- Shift lever
84 -- Shift position sensor
90 -- Control CPU
90 a--RAM
90 b--ROM
91 -- 1st drive circuit
92 -- 2nd drive circuit
94 -- Dc-battery
95 96 -- Current detector
97 98 -- Current detector
99 -- Remaining capacity detector
100 -- Actuator
102-108 -- Gear
120 -- Change gear
122 -- Belt attachment component
124 -- Belt attachment component
125 -- Belt
126 -- Actuator

129 -- Connection shaft
130 -- Change gear
200 -- Planetary gear
221 -- Sign gear
222 -- Ring wheel
223 -- Planetary pinion gear
223 -- Planetary carrier
225 -- Sun gear shaft
226 -- Ring wheel shaft
227 -- Planetary carrier shaft
228 -- Power extract gear
229 -- Power transfer belt
L1, L2 -- Power-source Rhine
Tr1-Tr6 -- Transistor
Tr11-Tr16 -- Transistor
MG1, MG2 -- Motor

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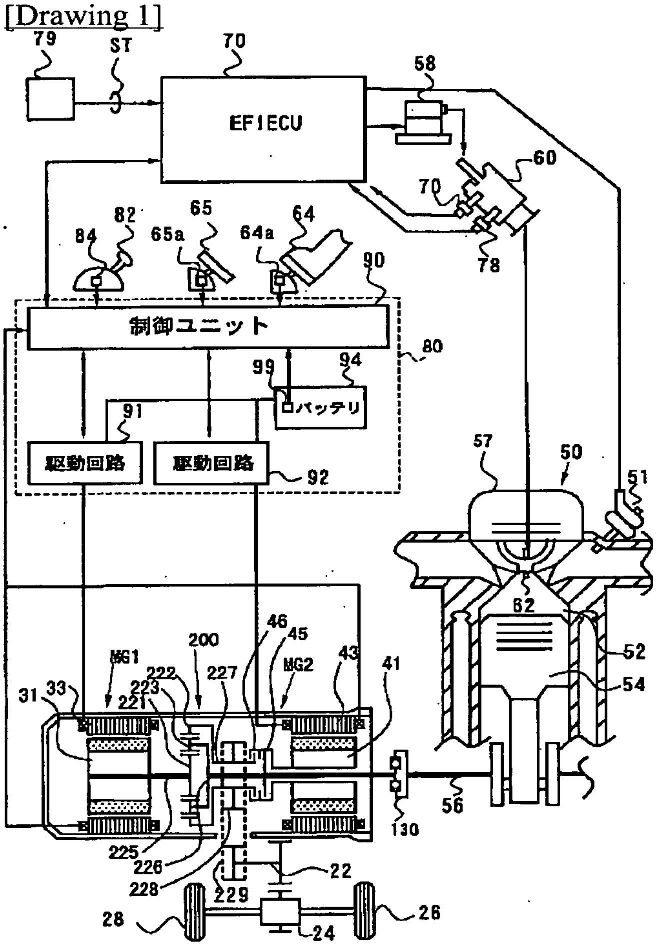
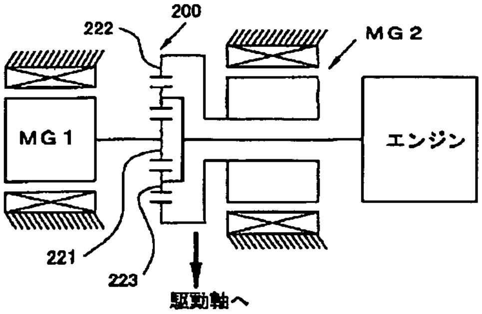
[Translation done.]

DRAWINGS

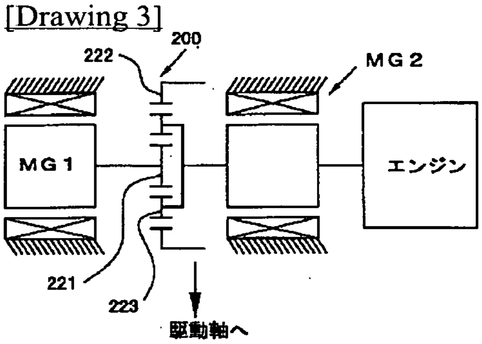
[Drawing 1]



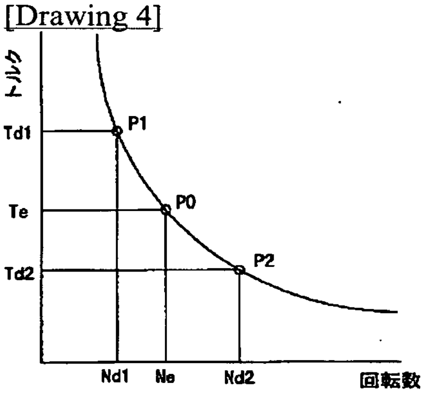

[Drawing 2]



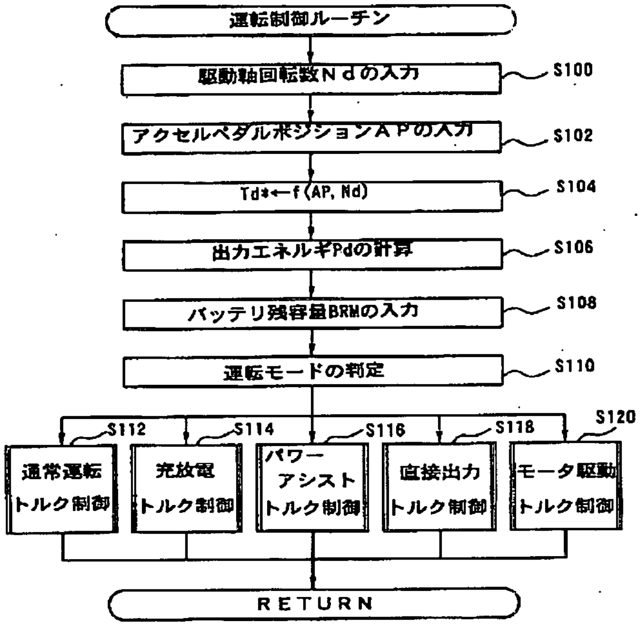

[Drawing 3]



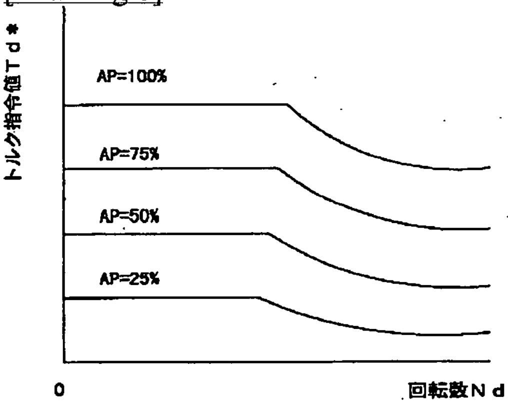

[Drawing 4]



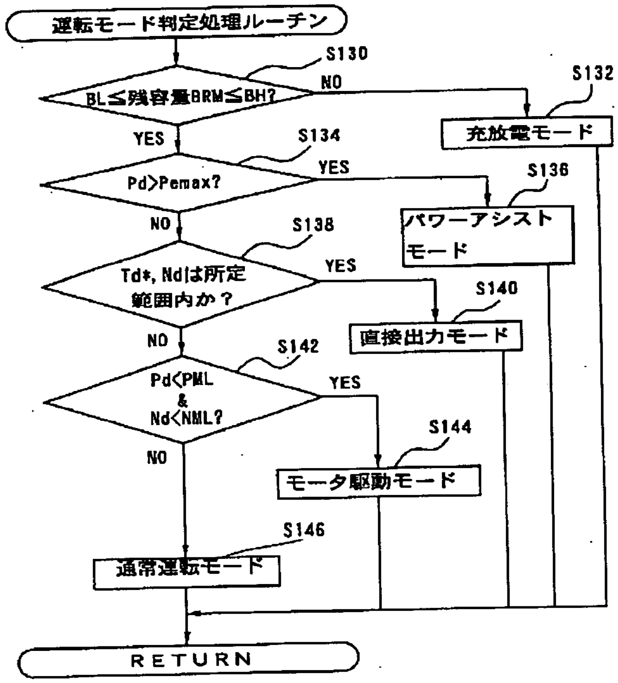

[Drawing 5]



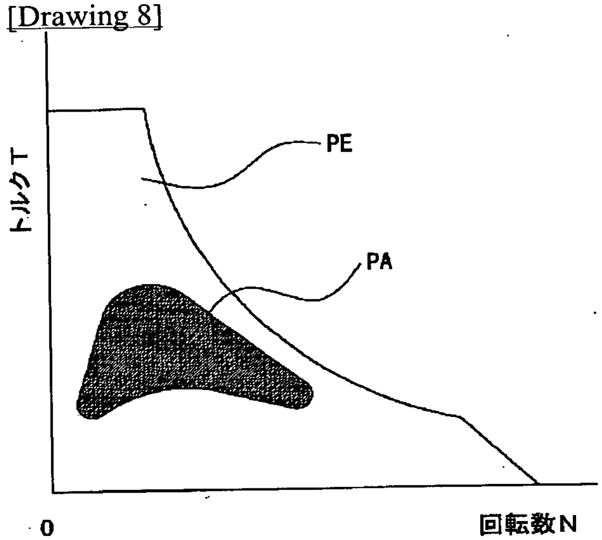

[Drawing 6]



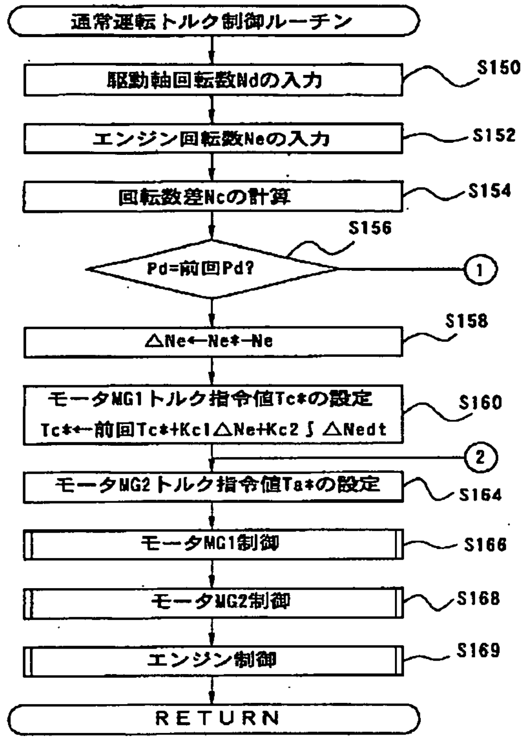

[Drawing 7]



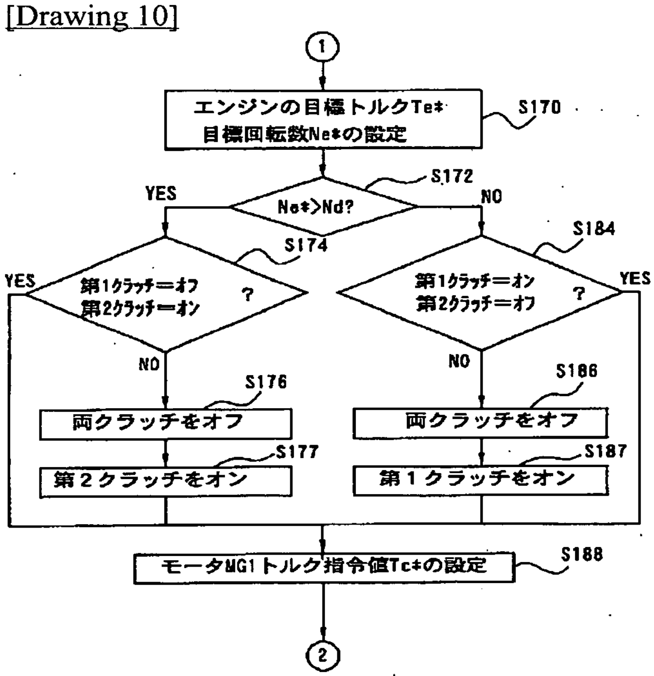

[Drawing 8]



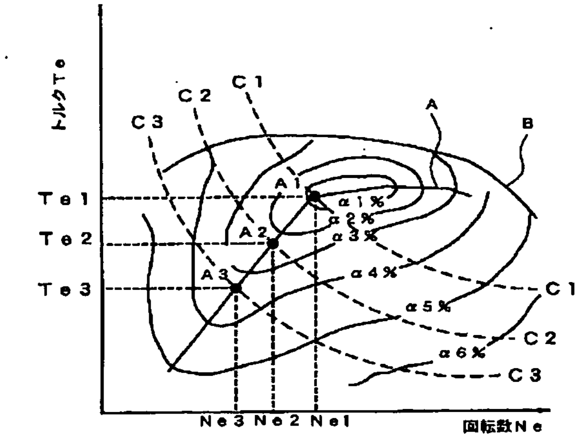

[Drawing 9]



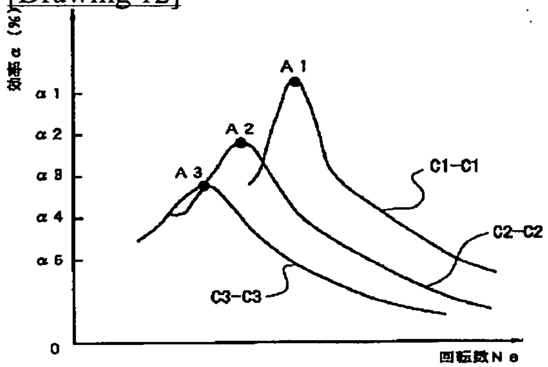

[Drawing 10]



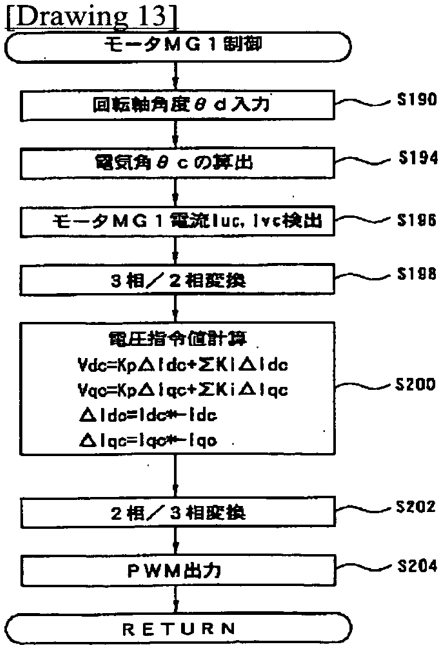

[Drawing 11]



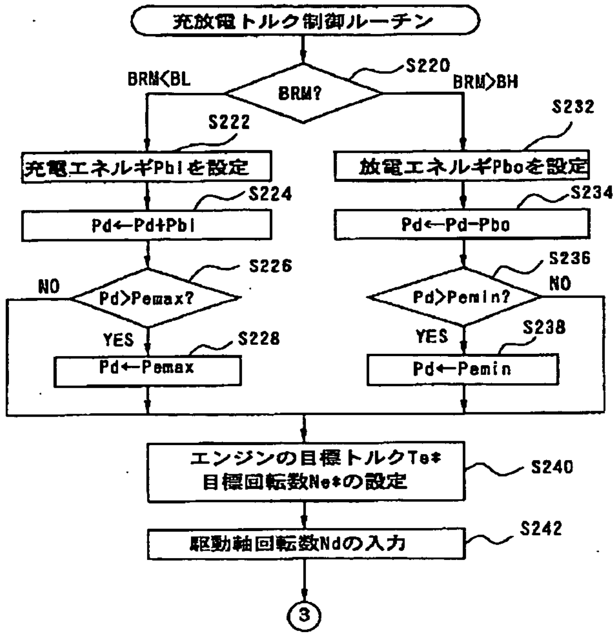

[Drawing 12]



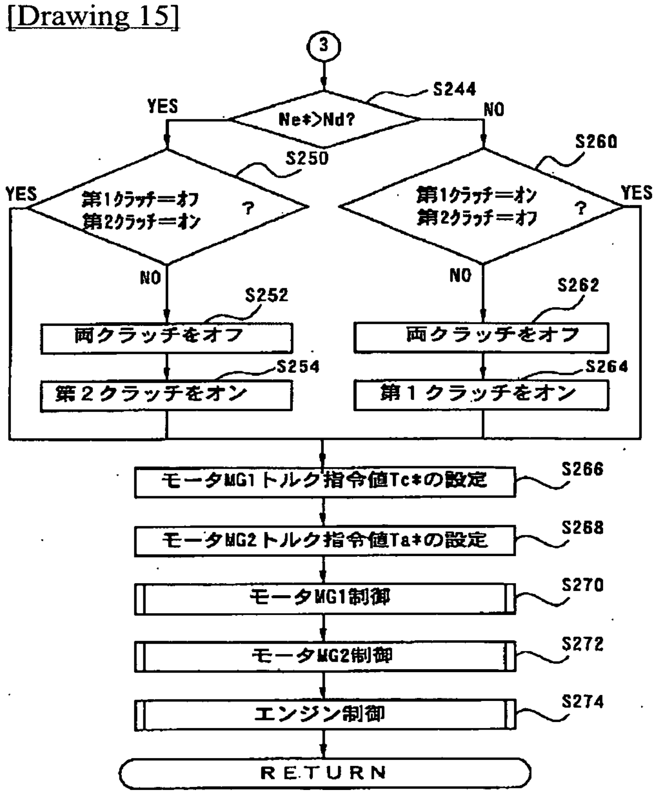

[Drawing 13]



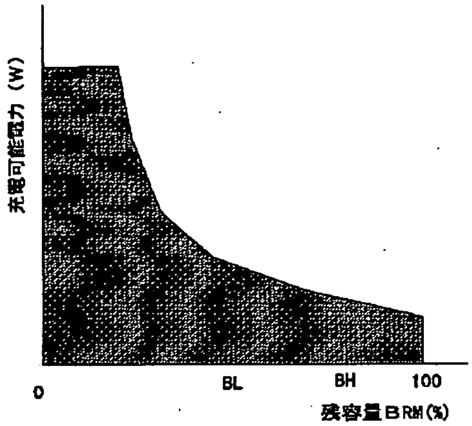

[Drawing 14]



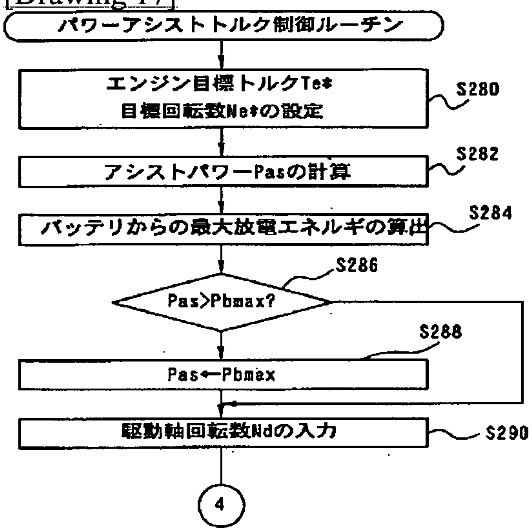

[Drawing 15]



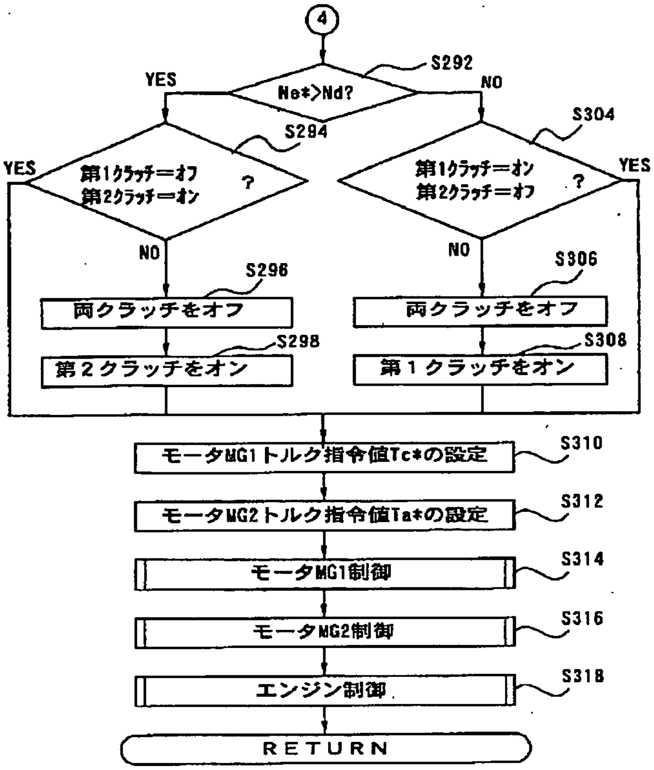

[Drawing 16]



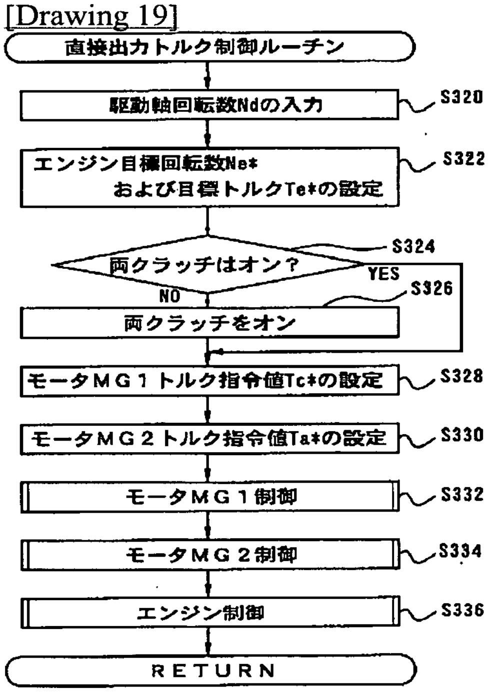

[Drawing 17]



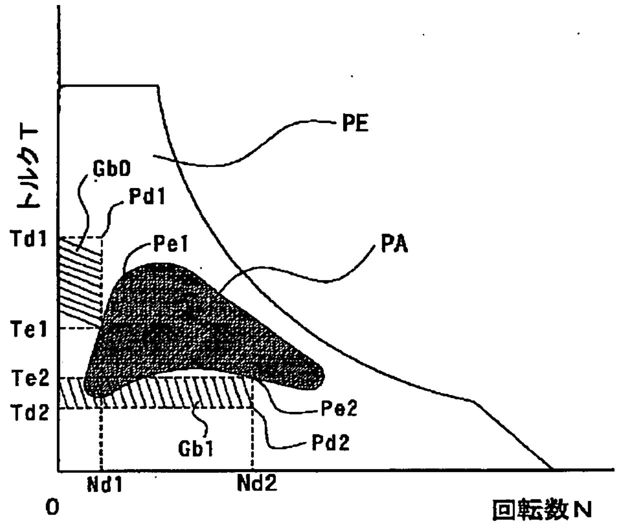

[Drawing 18]



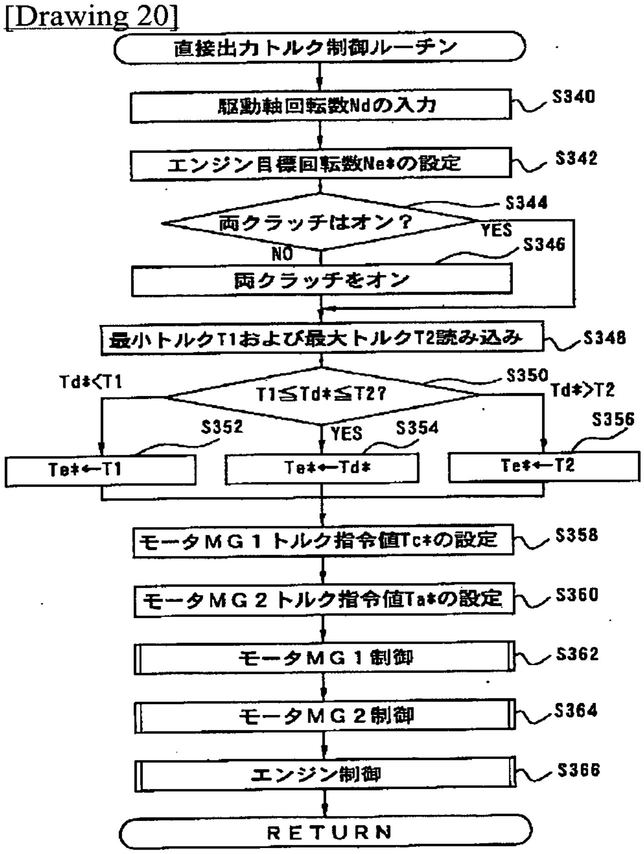

[Drawing 19]



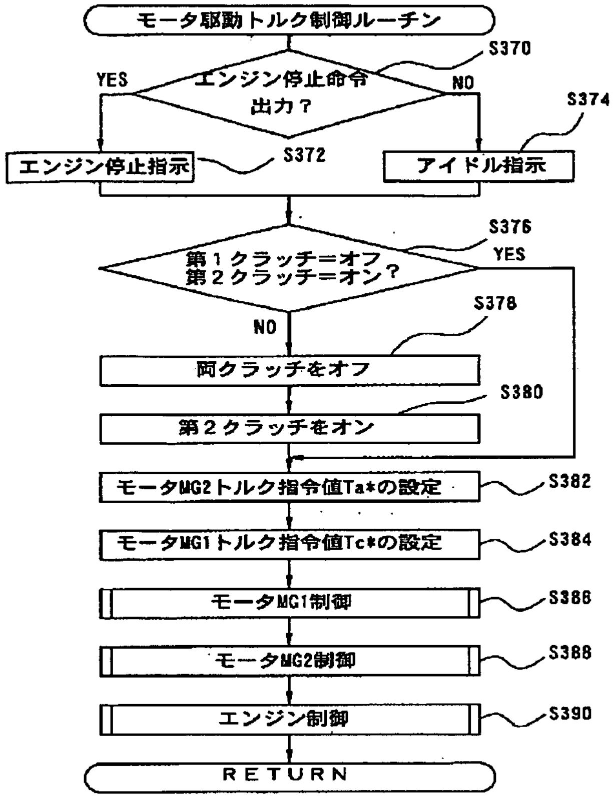

[Drawing 21]



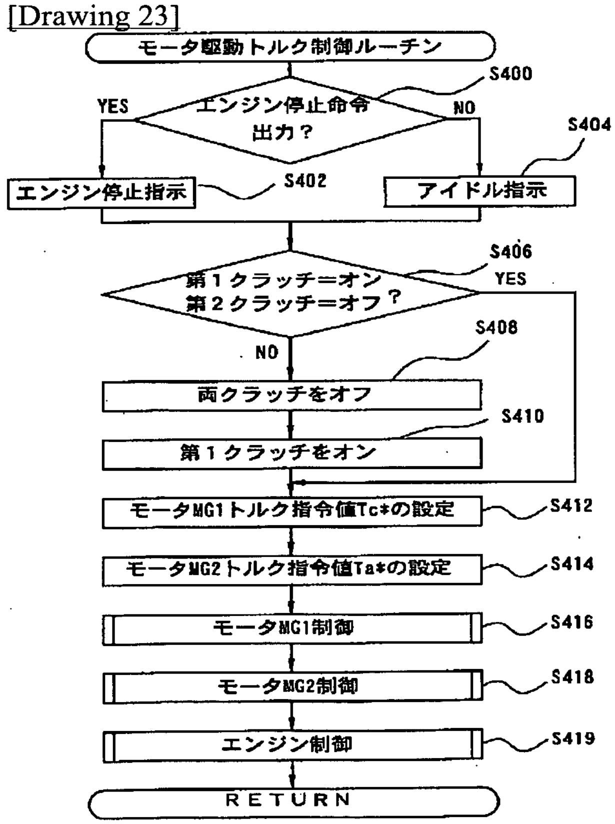

[Drawing 20]



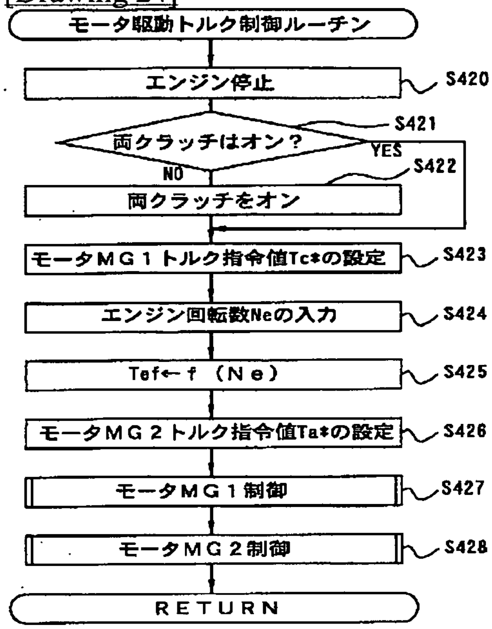

[Drawing 22]


モータ駆動トルク制御ルーチン
S370
エンジン停止命令出力？
YES
NO
S374
エンジン停止指示
S372
アイドル指示
S376
第1クラッチ=オフ
第2クラッチ=オン？
YES
NO
S378
両クラッチをオフ
S380
第2クラッチをオン
モータMG2トルク指令値Ta*の設定
S382
モータMG1トルク指令値Tc*の設定
S384
モータMG1制御
S386
モータMG2制御
S388
エンジン制御
S390
RETURN

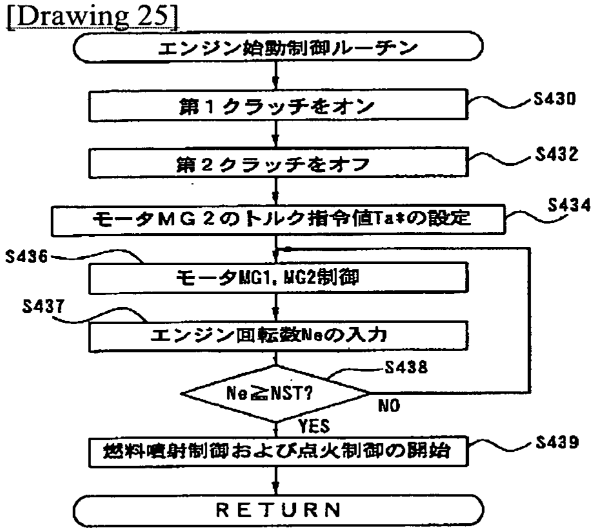
[Drawing 23]


モータ駆動トルク制御ルーチン
S400
エンジン停止命令出力？
YES
NO
S404
エンジン停止指示
S402
アイドル指示
S406
第1クラッチ=オン
第2クラッチ=オフ？
YES
NO
S408
両クラッチをオフ
S410
第1クラッチをオン
モータMG1トルク指令値Tc*の設定
S412
モータMG2トルク指令値Ta*の設定
S414
モータMG1制御
S416
モータMG2制御
S418
エンジン制御
S419
RETURN

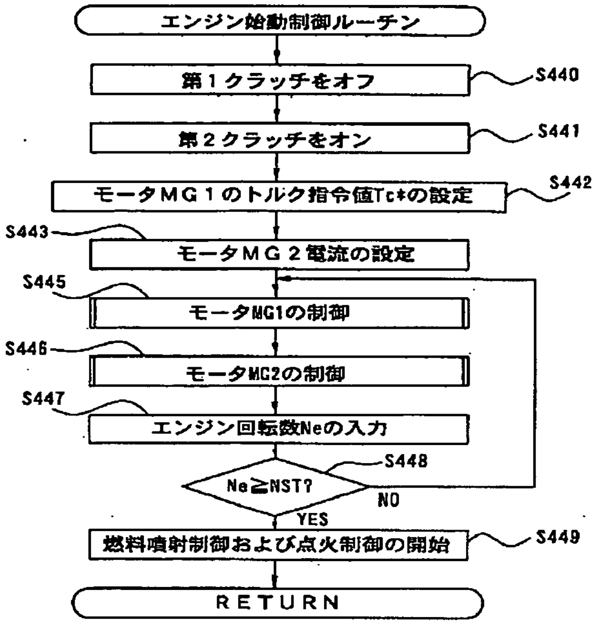
[Drawing 24]



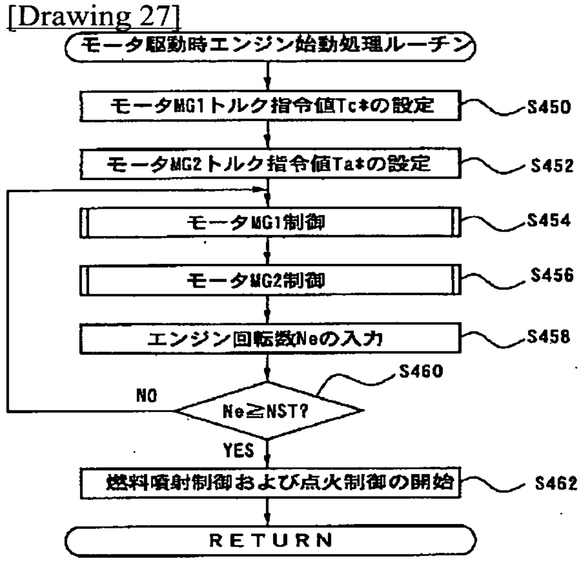

[Drawing 25]



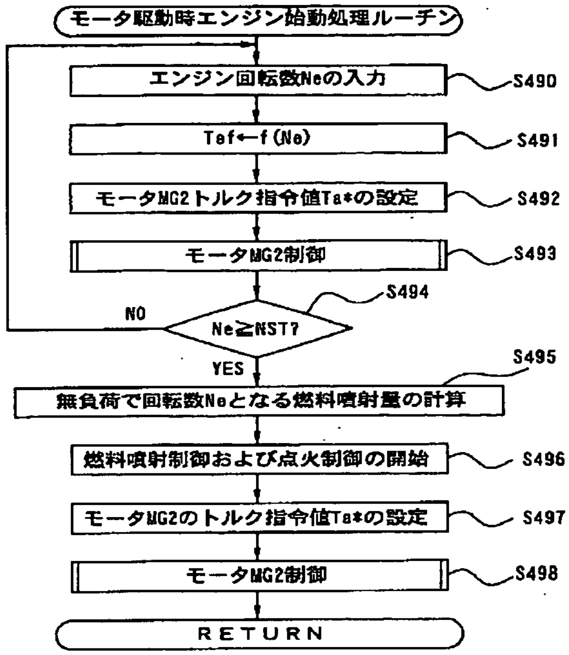

[Drawing 26]



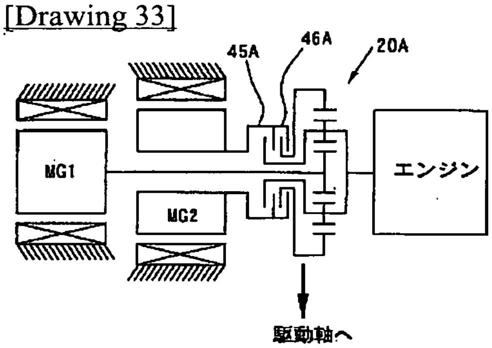

[Drawing 27]



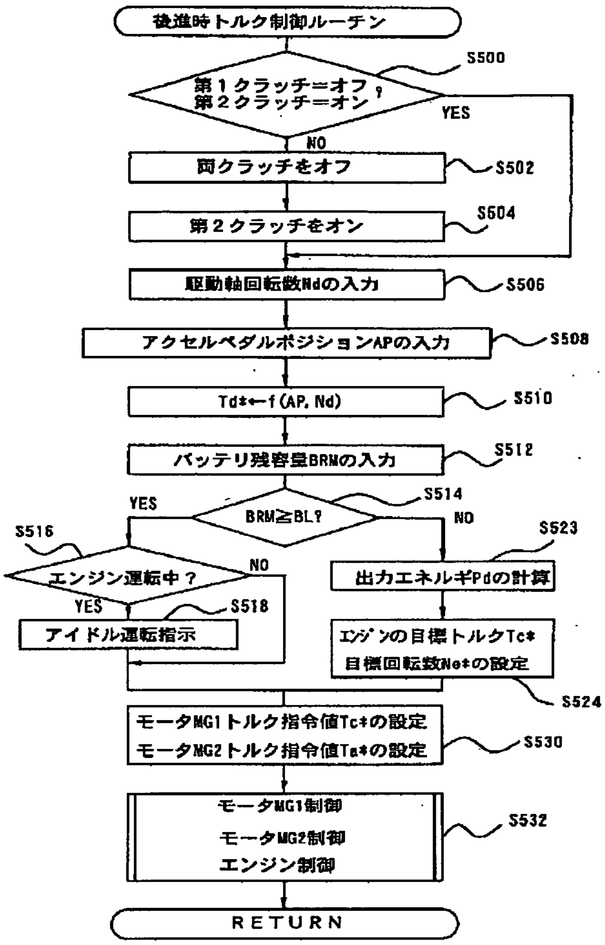

[Drawing 28]



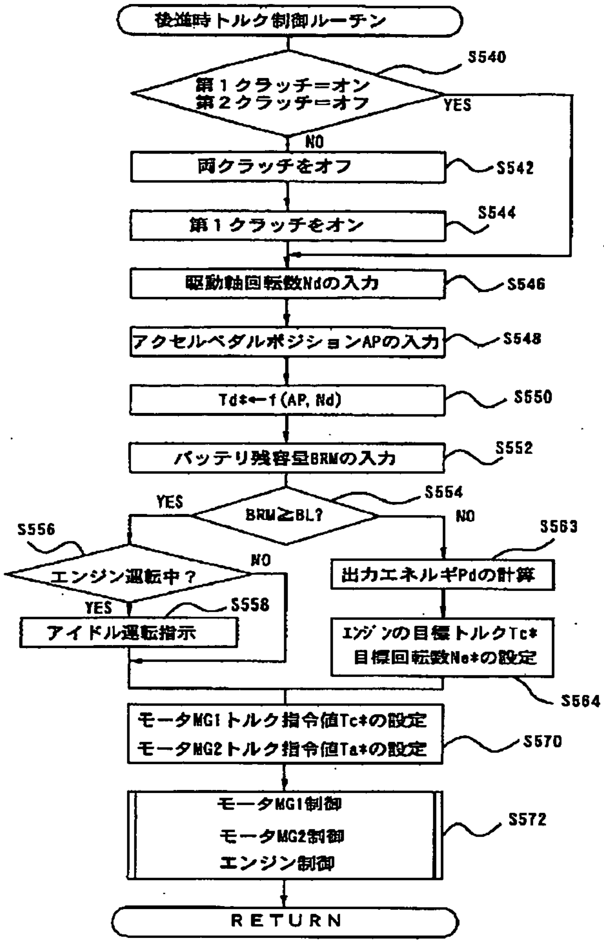

[Drawing 33]



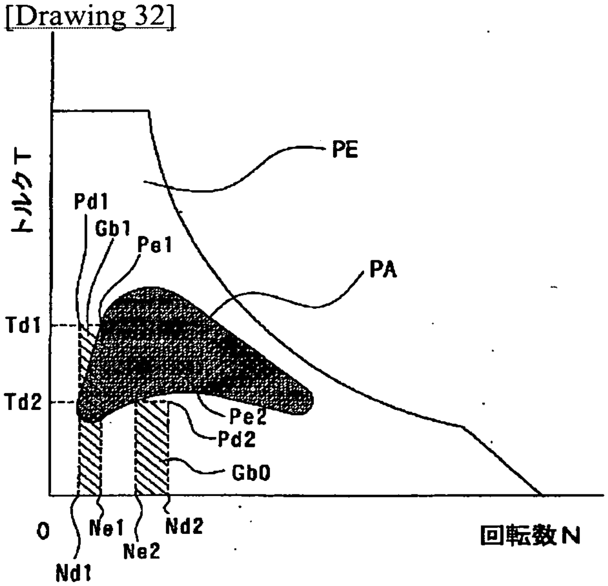

[Drawing 29]


後進時トルク制御ルーチン
S500
第１クラッチ＝オフ？
第２クラッチ＝オン
YES
NO
両クラッチをオフ
S502
第２クラッチをオン
S504
駆動軸回転数Ndの入力
S506
アクセルペダルポジションAPの入力
S508
Td*←f(AP, Nd)
S510
バッテリ残容量BRMの入力
S512
YES
BRM≧BL?
S514
NO
S523
S516
エンジン運転中？
NO
出力エネルギPdの計算
YES
S518
アイドル運転指示
エンジンの目標トルクTc*
目標回転数Ne*の設定
S524
モータMG1トルク指令値Tc*の設定
モータMG2トルク指令値Ta*の設定
S530
モータMG1制御
モータMG2制御
エンジン制御
S532
RETURN

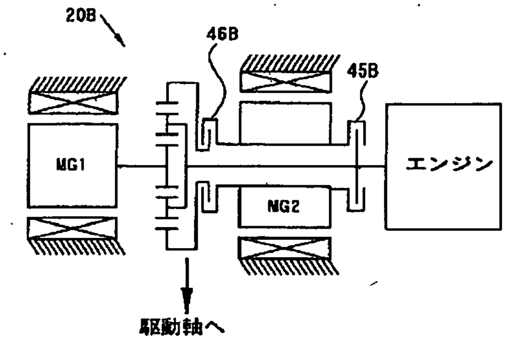
[Drawing 30]



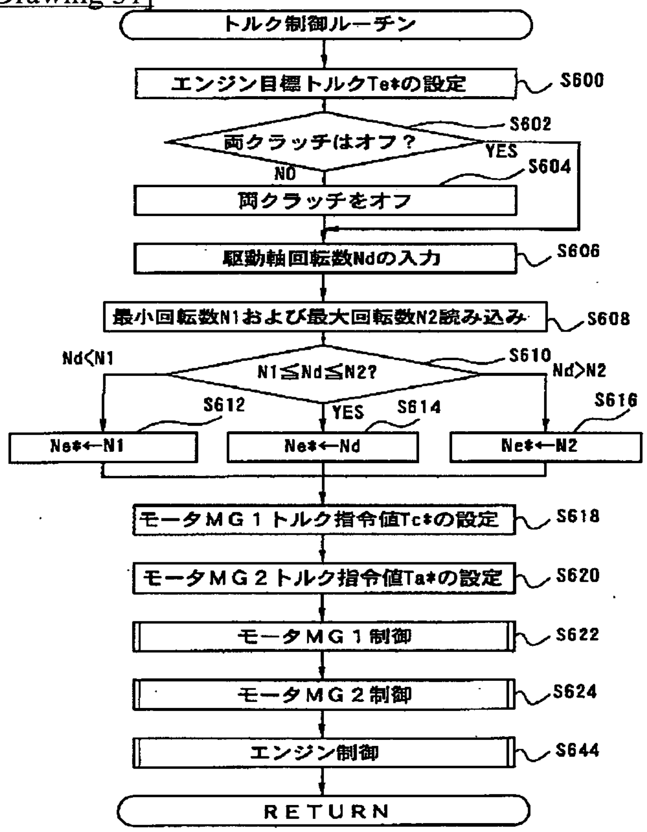

[Drawing 32]



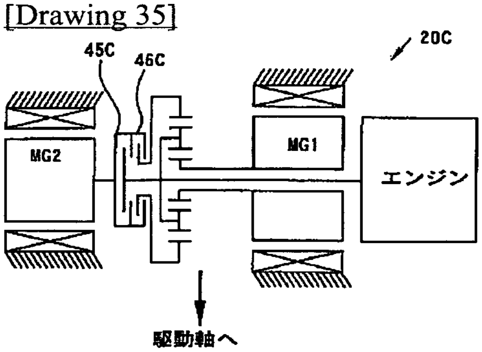

[Drawing 34]



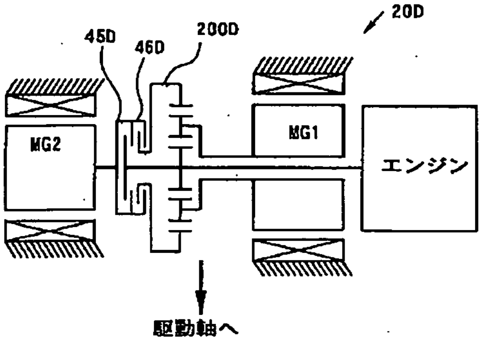

[Drawing 31]



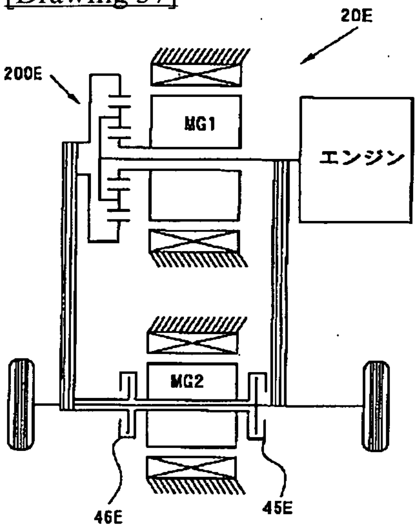

[Drawing 35]



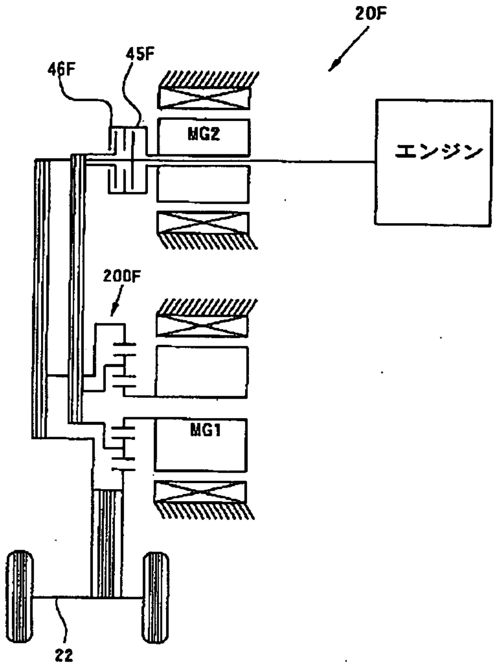

[Drawing 36]



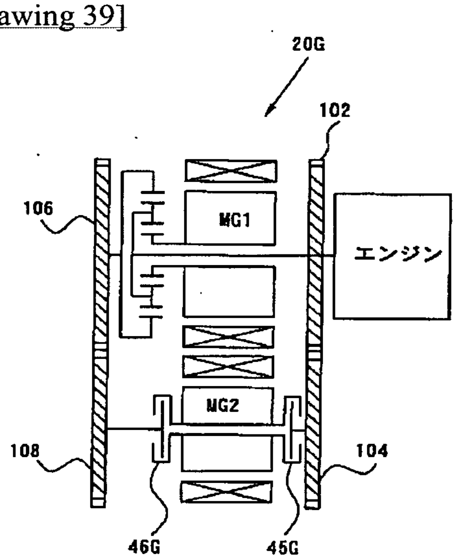

[Drawing 37]




[Drawing 38]

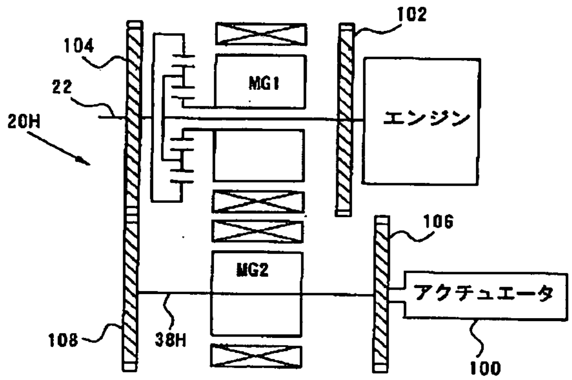



[Drawing 39]

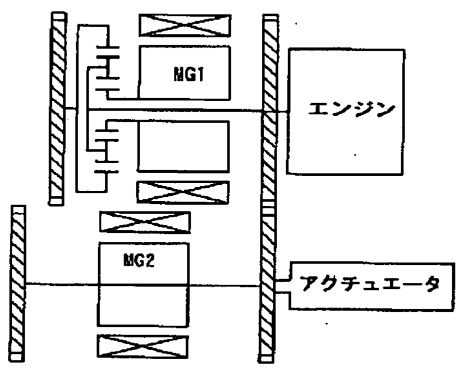



[Drawing 40]

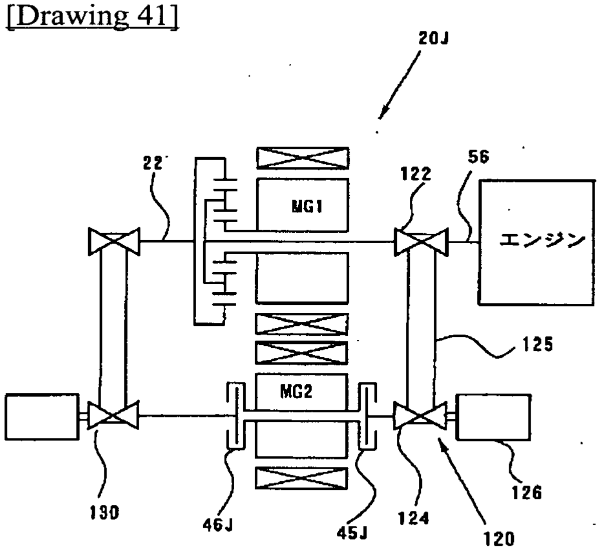
(a)




(b)




[Drawing 41]

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[Translation done.]